SOIL SURVEY OF NORTH FERRY AREA, WASHINGTON
PARTS OF FERRY AND STEVENS COUNTIES

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THE NORTH FERRY AREA is in the northeastern part of Washington (fig. 1). It has a total area of 778,790 acres, or 1,217 square miles. Colville National Forest covers 523,000 of these acres. The survey area covers the northern half of Ferry County, 100 square miles in northwestern Stevens County, and 4 square miles in Okanogan County. It is east of the Columbia River and is bounded on the north by the international boundary with Canada. The southern boundary is the Colville Indian Reservation, approximately 1 1/2 miles south of latitude 48° 30' north. Except for the small contiguous acreage in Okanogan County, the western boundary is the Okanogan-Ferry County line.

The area is characterized by a hilly to mountainous topography and narrow stream valleys. For the most part, the stream valleys are oriented in a north-south direction. The Kettle River Range, a part of the Okanogan Highlands, divides the area into two parts. This range rises to an elevation of 5,000 to more than 7,000 feet and is crossed by the highest all-weather road in the State. Copper Butte, the high point of this range, rises to an elevation of 7,135 feet.

The only railroad in the area follows the Kettle River north from Kettle Falls to Laurier and then extends west to Grand Forks in Canada. It returns to Washington at Danville, continues south through Curlew and Malo, and ends at Republic.

Republic, the county seat, overlooks the San Poil River Valley, which is in western Ferry County. The largest town in the survey area, it had a population of 862 in 1970. The San Poil River, Curlew Creek, and the Kettle River are the three main streams draining the western part of the area. Curlew Lake, approximately 885 acres in size, is just north of Republic.

The chief industries are lumbering, mining, and farming. The lumber industry relies mainly on State and Federal forest land for its raw material. All farm woodlots have been cut once and some twice. Most of the timber cut is milled at local sawmills or trucked over Sherman Pass to Kettle Falls. Some rough lumber is exported to Canada. The major timber types are Douglas-fir, western larch, and ponderosa pine.

The Republic mining district has the second largest producing lode gold mine in the United States. A number of the mountains in the area contain, besides gold, deposits of copper, iron, silver, lead, and other ores.

Breeding and raising beef cattle is the chief farming enterprise. Hay and small grain are the main crops. About half the farms and ranches employ the operator full time. The average size of the full-time farm or ranch is about 2,000 acres. Part-time operators work off their farms as loggers or miners or as ranch hands on full-time ranches.

Recreational use of uncultivated soil is expanding.

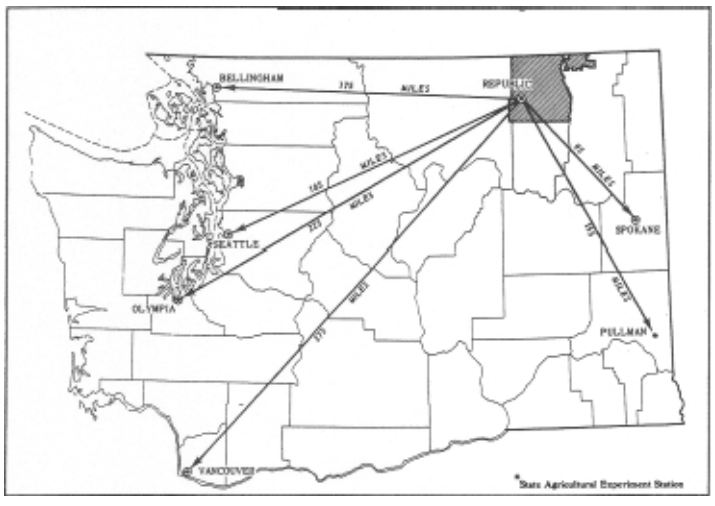

Figure 1.-Location of the North Ferry Area in Washington.

See also "Soils of the Republic and Kettle Falls Rangers Districts, Colville National Forest," Forest Service Report, November 1969.

Others who assisted in the survey are DR. STEPHAN H. KRASHEVSKI, Washington State University, GEORGE CAWLFIELD and RONALD MCCONNELL, Forest Service, and GERALD L. RICHARD, Soil Conservation Service. The soils were correlated by ALLEN R. HIDLEBAUGH, Soil Conservation Service.

The area is well supplied with game. White-tailed deer and mule deer, bear, mountain lion, grouse, and turkey are hunted. Some well-stocked lakes offer excellent fishing and other recreational activities.

The economy of the North Ferry Area is hindered in its development by the long distance to markets, the short growing season, and the scarcity of soil suitable for intensive farming. Most soils are suited to woodland, range, wildlife, recreation, and Christmas trees. Some are suited to dryland grain or hay. About 3,000 acres is used for irrigated grain and hay.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in the North Ferry Area, where they are located, and how they can be used. The soil scientists went into the area knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. *The soil series* and the *soil phase* are the categories of soil classification most used in this survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Republic and Toroda, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Chesaw sandy loam, 0 to 3 percent slopes, is one of several phases within the Chesaw series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, field borders, trees, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

Most of the forested acreage was mapped by a combination of aerial photographs and examination of soil profiles. Some inaccessible areas, however, were mapped by the use of aerial photographs alone. The cleared acreage is more accessible than the forested acreage, and smaller soil areas of the cleared acreage are mapped.

A mapping unit consists of all areas identified by a common symbol on a soil map. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. Three kinds of mapping units are shown on the soil map of the North Ferry Area: soil complexes, soil associations, and undifferentiated groups.

A soil complex consists of areas of two or more soils so intermingled or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. Generally, the name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Oxerine-Pepoon complex, 15 to 35 percent slopes, is an example.

A soil association is made up of adjacent soils that occur as areas large enough to be shown individually on the soil map but are shown as one unit because the time and effort of delineating them separately cannot be justified. There is a considerable degree of uniformity in pattern and relative extent of the dominant soils, but the soils can differ greatly one from another. The name of an association consists of one, two, or three series names. Grow den association, steep, is an example.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map is made up of only one of the dominant soils, or of two or more. If there are two or more dominant soils represented in the group, the name of the group ordinarily consists of the names of the dominant soils, joined by "and." Peat and Muck is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, so severely eroded, or so variable that it has not been classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Rock land is an example.

While a survey is in progress, soil scientists take soil samples needed for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soil in other places are also assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil. Yields under defined management are estimated for all the soils.

Soil scientists observe how soils behave when used as a growing medium for native and cultivated plants

and as material for structures, foundations for structures, or covering for structures. They relate this behavior to properties of the soils. For example, they observe that filter fields for onsite disposal of sewage fail on a given kind of soil, and they relate this failure to slow permeability or a high water table. They see that streets, road pavements, and foundations for houses are cracked on a given kind of soil, and they relate this failure to a high shrink-swell potential. Thus, they use observation and knowledge of soil properties, together with available research data, to predict the limitations or suitability of a soil for present and potential uses.

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. They then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under current methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in the North Ferry Area. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association can occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in an area, who want to compare different parts of an area, or who want to know the location of large tracts that are suitable for a certain kind of farming or other land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field or for selecting the exact location of a road, building, or similar structure because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The nine soil associations in this survey have been grouped into five general kinds of landscapes for broad interpretative purposes. The five broad groups and the nine soil associations in the North Ferry Area are described on the following pages.

Soils on Glacial Till Plains and Uplands

The two associations in this group are on ridges and hillsides at the lower elevations. They occupy about half of the survey area.

1. Molson-Edds-Rock land association

Nearly level to very steep, well-drained soils and Rock land at elevations above 1,900 feet

This association is on lower hills above the main drainage channels. In places, the hills are gently rounded and hillsides are short. In other places, long and steep or moderately steep slopes that are generally broken by gentle slopes or rock outcrop extend from hilltops or ridgetops downward into the narrow channels of small perennial streams. The hilltops are mostly rock outcrop. The vegetation is dominantly bunchgrass ; conifers have encroached, mainly on north-facing slopes. Clumps of aspen and cottonwood grow in depressions and in the shallow drainage channels on south-facing slopes. Elevations range from 1,900 to 4,500 feet, but are as high as 6,000 feet on south-facing slopes. The mean annual precipitation is 14 to 30 inches.

This association makes up about 15 percent of the survey area. It is about 44 percent Molson soils, 14 percent Edds soils, 12 percent Rock land, and 30 percent Vallan, Cobey, and Toroda soils. Molson and Edds soils dominate the hillsides. Rock land occurs within areas of Molson and Edds soils.

Molson soils have a surface layer of very dark gray stony loam and dark grayish-brown loam and a subsoil of brown loam and pale-brown gravelly loam. Edds soils have a surface layer of dark-gray and grayish-brown loam and a subsoil of light yellowish-brown clay loam and very pale brown loam. Rock land is mainly outcrop of andesite and very shallow, very stony soils.

Molson soils are used for dryfarmed hay, small grain, pasture, range, timber, and wildlife. Hay and small grain are grown principally on the gentle to moderately steep slopes. Edds soils and the steeper Molson soils are used for woodland and range (fig. 2). Available water capacity is low to high on this association.

Rock land supports little to no vegetation and is best suited to wildlife. Stock water is available from springs and potholes in areas of Molson soil and from streams draining the association. Wildlife is mainly deer and upland game birds.

Controlling runoff and weeds and keeping the soils in good tilth are important in managing the acreage in crops.

Controlling the number of livestock, developing springs, reseeding suitable range, and fencing the range into units that permit a deferred and rotation system of grazing are important in managing the range. The average ranch is about 2,000 acres in size.

2. Nevine-Pepoon-Oxerine association

Nearly level to very steep, well-drained, cool soils at elevations above 2,000 feet

This association is on uplands between the grasslands at the lower elevations and the fir-spruce forests at the higher elevations. The main drainage channels are narrow and oriented in a dominantly southeast to northwest direction. North-facing slopes are steep and break abruptly from the ridges into the drainageways. The ridges are gently rounded, and bedrock is exposed in many places. South-facing slopes are longer and less steep. Many are gently sloping to moderately steep. At the lower elevations, these slopes support open stands of ponderosa pine and bunchgrass. At the higher elevations are mixed stands of pine, Douglas-fir, and larch

Figure 2.-Typical range on Molson-Edds-Rock land association. Growden soils are in the distant background. Forested areas are on the Nevine-Pepoon-Oxerine association.

and on the shaded slopes thick stands of fir and larch. Lodgepole pine is dominant in the old burn areas. Elevations range from 2,000 to 6,000 feet. The annual precipitation is 17 to 35 inches.

This association makes up about 43 percent of the survey area. It is about 37 percent Nevine soils, 13 percent Pepoon soils, 11 percent Oxerine soils, and 39 percent Bamber, Merkel, Inkler, Aits, Vallan, and Donavan soils. Nevine, Oxerine, and Bamber soils dominate the hillsides. Pepoon soils are on the shallow, rocky hilltops, on ridges and knobs, and in some areas on side slopes.

Nevine soils have a thin surface layer of light brownish-gray loam and a subsoil of pale-brown and very pale brown loam. Below this, to a depth of more than 5 feet, are weakly cemented layers of gravelly sandy loam or gravelly loam. Pepoon soils are very dark gray and very dark brown extremely stony loams that are only 8 to 15 inches deep over granitic bedrock. Oxerine soils have a surface layer of brown loam and a subsoil of pale-brown gravelly loam or very gravelly loam. They are 20 to 40 inches deep over bedrock. The less extensive Bamber soils have a surface layer of light brownish-gray loam and a subsoil of dark-brown gravelly loam and strong-brown very gravelly loam. Andesite is at a depth of 40 to 60 inches.

This association is important for timber production. Most of it has been logged and now supports secondgrowth forest. Because the soils on south-facing slopes are drier, they are better suited to pine than to fir. Fir does become established where conditions are favorable, but it grows in clumps, not in solid stands. Stock water is available from springs and streams. A few areas were cleared and cultivated, but are now pastured and are slowly reverting to trees. Wildlife is mainly deer and upland game birds.

Thinning overstocked stands and reseeding skid trails, landings, and old crop fields with suitable grasses are important in management. In addition, the proper distribution of salt blocks minimizes overgrazing in some areas.

There are very few farm or ranch homes on this association.

Soils on Glacial Outwash Plains

The two associations in this group are on scattered terraces and bench escarpments and in basins and

alluvial stream bottoms throughout the survey area. The acreage is small.

3. Chesaw-Mires association

Nearly level to very steep, somewhat excessively drained and well drained soils formed under grass

This association is mainly in Curlew Valley. It also occurs as small areas along the narrow drainage channels leading into this valley. The landscape is one of remnant terraces having nearly level tops abruptly broken by steep escarpments; remnant fans covering parts of the terraces; and in some outwash terraces, especially along the east side of Curlew Lake, deep pits or depressions that once contained ice blocks left by a melting and retreating glacier. The steep escarpments are stony and cobbly. The vegetation is chiefly bunchgrass. Scattered stands of ponderosa pine have become established in protected areas along the drainage channels and in some nearly level areas. Elevations range from 1,800 to 3,500 feet. The mean annual precipitation is 14 to 20 inches.

This association makes up about 2 percent of the survey area. It is about 43 percent Chesaw soils, 34 percent Mires soils, and 23 percent Republic and Hunters soils. Mires soils dominate the nearly level terraces, Chesaw soils the escarpments, and Republic soils the gently sloping terraces and fans. Hunters soils are in areas that range from nearly level to steep.

Mires soils are well drained, have a surface layer of dark-gray and dark grayish-brown loam and a subsoil of yellowish-brown gravelly sandy loam, and are 17 to 29 inches deep over gravelly sand or gravelly loamy sand. Chesaw soils are somewhat excessively drained, have a surface layer of dark-gray and brown gravelly loamy sand, and are 14 to 24 inches deep over gravelly sand. Republic soils are well drained and have a surface layer of dark-gray loam and grayish-brown sandy loam and a subsoil of brown gravelly sandy loam. Below the subsoil to a depth of 60 inches is pale-brown and light grayish-brown gravelly sandy loam.

Most of this association is used for range or is dryfarmed in an alfalfa-grain rotation. The area around Curlew Lake is used for summer homes. Where water is available, some nearly level to sloping areas of Hunters, Mires, and Republic soils are sprinkler irrigated. Water supplies for livestock are limited. Springs and streams in the adjacent association are the major sources of stock water.

Controlling the number of livestock, reseeding suitable range, and fencing the range into units for deferred and rotation grazing are important management needs.

The association furnishes good quality forage, but most of the range is easily accessible to cattle and is overgrazed. Some soils provide a good source of sand and gravel for building foundation and subgrade road construction.

4. Torboy-Wapal-Gahee association

Nearly level to very steep, well drained and somewhat excessively drained soils formed under trees

This association occurs as scattered areas throughout the survey area. The largest areas are near Copper Lakes and along the Sherman, Boulder, and Trout Creek drainageways. The landscape is one of long and narrow eskers, nearly level terraces broken by escarpments, and alluvial stream bottoms. The escarpments are stony and cobbly. In places the surface is pitted and slopes are rolling and hilly. The vegetation is Douglas-fir, ponderosa pine, larch, lodgepole pine, and an understory of pinegrass and kinnikinnick. Elevations range from about 2,000 to 6,500 feet. The mean annual precipitation is 15 to 35 inches.

This association makes up about 8 percent of the survey area. It is about 30 percent Torboy soils, 15 percent Wapal soils, 13 percent Gahee soils, and 42 percent Shaskit, Tonata, Goddard, and other soils. Torboy, Gahee, and Goddard soils are on terraces and at terrace edges. Wapal soils are on the long, narrow eskers. Shaskit and Tonata soils are on alluvial stream bottoms.

Torboy soils are well drained. They have a surface layer and subsoil of pale-brown sandy loam and are 24 inches deep over loose gravelly sand. Wapal soils are similar to Torboy soils, but are only 10 to 23 inches deep over loose gravelly sand. Gahee soils are well drained and have a surface layer of pinkish-white very fine sandy loam and a subsoil of light-brown loam. They are 26 to 36 inches deep over very coarse sand.

Most of this association is used for timber, for summer grazing by cattle, and for wildlife. Small areas were cleared for crops, but are now abandoned and are slowly reverting to forest. Wildlife is mainly deer and upland game birds.

Soils on Terraces and Alluvial Fans

The only association in this group is on high terraces and alluvial fans in the warmer, eastern part of the survey area. The acreage is small.

5. Springdale-Bisbee-Scala association

Nearly level to steep, somewhat excessively drained and well drained soils

This association, a long, narrow strip between the rocky uplands to the west and the Kettle River and Lake Roosevelt to the east, is a small but important part of the survey area. The only crops in the eastern part of the survey area are grown on this association. Terraces have level to hilly tops and steep sides. Some high terraces are strongly dissected, especially those near Orient. The vegetation is coniferous trees, shrubs, and grasses. Elevations range from 1,300 to 2,800 feet. The mean annual precipitation is 17 to 21 inches.

This association makes up about 2 percent of the survey area. It is about 25 percent Springdale soils, 15 percent Bisbee soils, 15 percent Scala. soils, and 45 percent Cedonia, Dart, Hodgson, and other less extensive soils. Bisbee soils dominate the undulating to hilly, wind-reworked dunes. The rest are on the level or gently sloping terrace tops and on the steep terrace sides.

Springdale soils are somewhat excessively drained, have a surface layer of dark-gray and dark grayishbrown gravelly loam, and are 8 to 18 inches deep over gravelly loamy coarse sand. Bisbee soils are somewhat excessively drained. They have a surface layer of grayish-brown loamy fine sand and an upper sub-

stratum of pale-brown or light yellowish-brown loamy fine sand and are 24 to 44 inches deep over clean sand. Scala soils are well drained. They have a thin surface layer of grayish-brown fine sandy loam and a subsoil of brown or pale-brown fine sandy loam.

This association is used for hay, grain, and pasture. Some of the major soils are suitable for irrigation. Available water capacity is high in Scala soils, but low or very low in Springdale and Bisbee soils. Stock water is available from streams.

Other important uses are timber, homesites, and wildlife. Most of the association is in second-growth ponderosa pine and Douglas-fir. Some stands have been thinned for increased production of wood and grass. Most of the population in the eastern part of the survey area is on this association.

Thinning overstocked stands, controlling erosion, improving tilth, and reseeding old crop fields with suitable grasses are important management needs.

Farms and ranches range in size from several hundred to more than 1,000 acres. Most ranchers use Government-owned grazing land.

Soils on Flood Plains

The only association in this group is on recent stream bottoms. The acreage is very small.

6. Malo-Ret association

Nearly level, well drained and somewhat poorly drained soils

This association borders two major rivers-the San Poil and the Kettle. The flood plain is dominantly narrow, but from Laurier to Lake Roosevelt it is wide. The vegetation is coniferous trees, deciduous trees, shrubs, and grasses. In many places the timber has been cut. Elevations range from 1,500 to 3,000 feet. The mean annual precipitation is 14 to 19 inches.

This association makes up about 1 percent of the survey area. It is about 32 percent Malo soils, 32 percent Ret soils, and 36 percent Mixed alluvial land, Riverwash, and less extensive soils. Malo soils are in slightly higher positions than Ret soils. Ret soils dominate the low positions or depressions along the meandering San Poil River.

Malo soils are well drained, have a surface layer of dark grayish-brown or grayish-brown silt loam or sandy loam, and are underlain mostly by light brownish-gray or light yellowish-brown sandy loam. Ret soils are somewhat poorly drained, have a surface layer of dark-gray or dark grayish-brown silt loam and underlying layers of mostly loam or silt loam, and are mottled with dark yellowish brown at a depth of 30 inches. The Ret variant, included in this association as one of the less extensive soils, is mottled with dark brown at a depth of 18 inches and is poorly drained.

In spring, the parts of this association at lower elevations are subject to flooding or are subirrigated. Ret soils are usually saturated, and water stands on the surface as long as the river level is high. Water stands on the surface for longer periods on the poorly drained Ret variant, which has poor internal drainage and lacks adequate outlets. Artificial drainage is needed for pasture and hay crops.

Most of this association is used for hay, small grain, pasture, and a few row crops. Many of these crops are irrigated. The available water capacity is high.

The wet soils provide excellent habitat for waterfowl, such as mallard ducks, and for animals, such as mink and beaver. The drier soils are suitable as building sites and as picnic areas, campgrounds, and other recreation sites.

Keeping the soils in good tilth, controlling weeds, and using a grain-grass and legume rotation are important management needs.

Soils on Uplands and Mountains

The three associations in this group are on ridges and mountainsides. They make up about one-third of the survey area.

7. Vallan-Bamber-Tenas association

Moderately steep to very steep, well-drained soils at elevations above 3,000 feet

This association is on uplands. The landscape is one of mountain ridges, knobs, and mountainsides. The ridges are gently rounded, and andesite bedrock is exposed in places. North-facing slopes are steeper and are not so long as south-facing slopes. The vegetation is mainly bunchgrass and scattered Douglas-fir and ponderosa pine on southern exposures and ridgetops. Western larch and Douglas-fir dominate the northern exposures. Elevations range from 3,000 to 6,500 feet. The annual precipitation is 15 to 35 inches.

This association makes up about 6 percent of the survey area. It is about 42 percent Vallan soils, 21 percent Bamber soils, 17 percent Tenas soils, and 20 percent Rock land and Manley and Scar soils. Vallan soils are on the rocky ridges, hilltops, and knobs; Bamber and Tenas soils are on the hillsides (fig. 3).

Vallan soils have a surface layer of brown loam and a subsoil of yellowish-brown loam and are 6 to 20 inches deep over andesite bedrock. Bamber soils have a surface layer of light brownish-gray loam and a subsoil of pink gravelly or very gravelly loam. They are 40 to 60 inches deep over fractured andesite bedrock. Tenas soils have a surface layer of very dark gray loam and a subsoil that is dominantly reddish gray extremely stony clay loam. They are 20 to 40 inches deep over andesite bedrock.

Most of this association is used for wildlife and timber and for summer grazing by cattle. Stock water is available from springs and streams. Wildlife is mainly deer and upland birds.

Thinning of overstocked stands and reseeding skid trails and landings with suitable grasses are important management needs.

This association is largely Government owned.

8. Growden-Leonardo-Rock land association

Moderately steep to very steep, well-drained soils and Rock land at elevations above 5,500 feet

This association is on ridges and uplands in mountainous areas. The tops of ridges are mostly rounded. Many of the sides have nearly vertical outcrops of rock. Many of the steep sides are highly dissected. The vegetation is mostly ponderosa pine, Douglas-fir, and

Figure 3.-Typical landscape on association 7. Bamber and Tenas soils are on the mountainsides, and Vallan soils and rock outcrop on the ridges.

an understory of Idaho and rough fescue, bluebunch wheatgrass, and forbs. Elevations range from below 5,500 to over 6,500 feet. The mean annual precipitation is 25 to 40 inches.

This association makes up 7 percent of the survey area. It is about 70 percent Growden soils, 15 percent Leonardo soils, 5 percent Rock land, and 10 percent Bamber, Inkier, and Aits soils. Rock land and the Growden and Leonardo soils, which are moderately steep to very steep, are on the warmer, drier slopes, dominantly the south-facing slopes.

Growden soils have a surface layer of dark grayish-brown and brown fine sandy loam. The underlying material is brown very stony or extremely stony sandy loam. Leonardo soils have a surface layer of dark grayish-brown fine sandy loam and underlying material of yellowish-brown extremely stony sandy loam. Rock land is mainly andesite and granite outcrop and less extensive areas of very shallow soil.

This association is important for timber, grazing, and wildlife. Stock water is available from springs and streams. Wildlife is mainly deer and upland birds.

Thinning overstocked tree stands and reseeding skid trails and landings with suitable grasses are important management needs. In addition, the proper distribution of salt blocks minimizes overgrazing in some areas.

This association is largely Government owned. There are very few farms or ranch homes on this association.

9. Togo-Manley-Scar association

Nearly level to very steep, well-drained, cold soils at elevations above 3,000 feet

This association is on ridges and mountainsides. The main drainage channels tend to be narrow and are oriented in an east-west direction. North-facing slopes are steep. They break abruptly from the ridges into the drainage channels. South-facing slopes are longer and less steep. The ridges are gently rounded. The vegetation is mostly mixed stands of subalpine fir, Engelmann spruce, larch, and Douglas-fir. Elevations range from 3,000 to about 6,500 feet. The mean annual precipitation is 20 to 40 inches.

This association makes up 16 percent of the survey area. It is 39 percent Togo soils, 18 percent Manley soils, 13 percent Scar soils, and 30 percent Rock land and Nevine, Pepoon, and Vallan soils. The moderately steep to very steep Togo soils are on northern exposures. Manley and Scar soils are on the nearly level ridgetops and the steeper sides, mainly on northern exposures.

Togo soils have a thin surface layer of gray loam, a subsoil of dark-brown loam or gravelly loam, and a substratum of brown gravelly or very gravelly sandy loam. Manley soils have a thin surface layer of light-gray loam, a subsoil of light-brown and light-yellowish-brown gravelly silt loam, and a substratum of light yellowish-brown gravelly sandy loam. Scar soils have a thin surface layer of gray very fine sandy loam, a subsoil of strong-brown sandy loam and loamy fine sand, and underlying layers of light-gray loamy sand and sandy loam. Rock land is mainly andesite and granite outcrop.

This association is important for timber production. Most of it has been logged or burned and now supports second-growth forest on the lower slopes.

Thinning overstocked stands and reseeding skid

trails and landings with suitable grasses are important management needs.

This association is largely Government owned. There are very few farms or ranch homes on this association.

Descriptions o f the Soils

This section describes the soil series and mapping units in the North Ferry Area. Each soil series is described in detail, and then, briefly, each mapping unit in that series. Unless it is specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second is much more detailed and is for those who need to make thorough and precise studies of soils. Color terms are for dry soil unless otherwise stated. The profile described in the series is representative of mapping units in that series. If the profile of a given mapping unit is different from the one described for the series, these differences are stated in describing the mapping unit, or they are differences that are apparent in the name of the mapping unit.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Rock land and Riverwash, for example, do not belong to a soil series, but nevertheless, are listed in alphabetic order along with the soil series.

Preceding the name of each mapping unit is a symbol. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit or subclass to which the mapping unit has been assigned. Also listed, for many mapping units, is the range site or the woodland subclass, or both. The page for the description of each capability unit or subclass can be found by referring to the "Guide to Mapping Units" at the back of this survey.

The acreage and proportionate extent of each maping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary at the end of this survey, and more detailed information about the terminology and methods of soil map
ping can be obtained from the Soil Survey Manual (8).

Aits Series

The Aits series consists of moderately well drained, moderately steep to very steep soils formed in volcanic ash overlying glacial till. These soils are on till plains, kames, and terraces at elevations of 2,500 to 4,000 feet. The vegetation is mainly Douglas-fir, larch, and lodgepole pine. The annual precipitation is about 30 inches. The mean annual air temperature is 42° F. The frost-free period is 90 to 110 days. Aits soils are associated with Nevine, Donavan, and Kiehl soils.

In a representative profile, a thin layer of organic litter is at the surface. Next, in sequence downward, is 12 inches of brown very fine sandy loam and loam, 5 inches of light-gray loam, 17 inches of grayish-brown gravelly loam, and 11 inches of light-gray gravelly loam that has pockets of grayish-brown gravelly clay loam. Below this to a depth of 60 inches is pale-olive very gravelly clay loam.

Permeability is moderate above a depth of 45 inches and slow below that depth. Available water capacity is low to moderately high. Roots penetrate to a depth of 60 inches or more.

Aits soils are used for woodland, wildlife, and grazing.

Representative profile of Aits loam, 15 to 35 percent slopes, in a forested area on roadcut uphill from new logging, sec. 26, T. 40 N., R. 37 E., Colville National Forest

O2-1 inch to 0, partly decomposed leaves, twigs, needles, and roots.

A1-0 to 2 inches, brown (10YR 5/3) very fine sandy loam, dark brown (10YR 4/3) moist; weak, fine, granular structure; soft, friable, nonsticky and nonplastic; many fine roots; surface has incipient gray appearance of A2 horizon development; slightly acid; abrupt, smooth boundary. 1 to 2 inches thick.

B2ir-2 to 12 inches, brown (7.5YR 5/4) loam, dark brown (7.5YR 3/4) moist; weak, fine and medium, subangular blocky and moderate, medium and coarse, granular structure; soft, friable, nonsticky and nonplastic; many fine roots; slightly acid; clear, wavy boundary. 9 to 12 inches thick.

IIA'21-12 to 17 inches, light-gray (10YR 7/2) loam, light olive brown (2.5Y 5/4) moist; moderate, medium and coarse, subangular blocky structure; hard, firm, nonsticky and nonplastic; few fine roots; many pores; 15 percent gravel; slightly acid; gradual, wavy boundary. 4 to 8 inches thick.

IIA'22-17 to 34 inches, grayish-brown (10YR 5/2) gravelly loam, dark grayish brown (2.5Y 4/2) moist; few pockets and lenses of clay loam, brown (10YR 4/3) moist; moderate, medium and fine, subangular blocky structure; hard, firm, slightly sticky and slightly plastic; many fine roots; many pores; 25 percent angular gravel; neutral; gradual, wavy boundary. 16 to 30 inches thick.

IIA'&B-34 to 45 inches, light-gray (2.5Y 7/2) gravelly loam, grayish brown (2.5Y 5/2) moist; pockets of grayish-brown (2.5Y 5/2) gravelly clay loam, very dark grayish brown (2.5Y 3/2) moist; B2 portion has moderate, medium and fine, angular blocky structure; A2 portion has moderate, medium and coarse, angular blocky structure; hard, firm, slightly sticky and slightly plastic; many pores; 25 percent angular gravel; slightly acid; gradual, wavy boundary. 10 to 14 inches thick.

IIB'2t-45 to 60 inches, pale-olive (5Y 6/3) very gravelly clay loam, olive (5Y 4/3) moist; some ped faces light olive brown (2.5Y 5/4) moist; moderate, medium and coarse, angular blocky structure; very hard, firm, sticky and plastic; many clay films on ped faces; 50 percent angular gravel; slightly acid.

The content of coarse fragments between depths of 10 and 40 inches ranges from 5 to 35 percent and is less than 20 percent by weighted average. Below 40 inches, it exceeds 35 percent. The soils are medium acid to neutral. The B'2t horizon is loam, clay loam, or sandy clay loam and is gravelly or very gravelly.

AlE-Aits loam, 15 to 35 percent slopes. This moderately steep to steep soil is on till plains, kames, and

In the original manuscript, there was a table in this space.
All tables have been updated and are available from http://soildatamart.nrcs.usda.gov.

terraces. It has the profile described as representative of the series. Included in mapping are small areas of Tenas and Bamber soils. Runoff is medium to rapid, and the erosion hazard is moderate to severe. This soil is used for woodland, wildlife, and grazing. Capability subclass IVe nonirrigated; woodland subclass 4o.

AoE-Aits-Rock land complex, 15 to 50 percent slopes. This moderately steep to very steep mapping unit is on till plains, kames, and terraces. It is 40 to 70 percent Aits loam and 30 to 60 percent Rock land. Runoff is medium to very rapid, and the erosion hazard is moderate to very severe. This mapping unit is used for woodland, wildlife, and grazing. Capability subclass VIIs nonirrigated; woodland subclass 4o for Aits soil, 5x for Rock land.

Anglen Series

The Anglen series consists of moderately well drained, nearly level to very steep soils formed in volcanic ash overlying glacial lake sediments. These soils are on terraces and terrace edges at elevations of 2,600 to 4,000 feet. The vegetation is mainly Douglas-fir, alder, larch, and willow. The annual precipitation is 17 to 30 inches. The mean annual air temperature is 41° to 43° F. The frost-free period is 90 to 130 days. Anglen soils are associated with Goddard, Merke1, Nevine, Talls, and Torboy soils.

In a representative profile, a thin layer of organic litter is at the surface. Next, in sequence downward, is 6 inches of very pale brown loam, the upper one-half inch of which is ashy gray ; 8 inches of white silt loam; and 29 inches of silty clay that is light brownish gray in the upper part and white in the lower part. Below this to a depth of 60 inches or more is light-gray silt loam.

Permeability is moderately slow. Available water capacity is high. Roots penetrate to a depth of 60 inches or more.

Anglen soils are used as woodland and wildlife habitat. They also provide grazing.

Representative profile of Anglen loam, 0 to 15 per-

cent slopes, in a forested area, NE1/4NW1/4 sec. 2, T. 35 N., R. 36 E., just west above Canyon Creek Road, Colville National Forest:

O1-1 inch to 0, decomposed mat of fine roots, leaves, twigs, and needles.

Bir-0 to 6 inches, very pale brown (10YR 7/4) loam, dark yellowish brown (10YR 4/4) moist; very weak, fine, granular structure; loose, very friable, nonsticky and nonplastic; many fine roots; upper one-half inch has ashy gray appearance of discontinuous A2 horizon development; neutral; clear, smooth boundary. 6 to 8 inches thick.

A2-6 to 14 inches, white (2.5Y 8/2) silt loam, light brownish gray (2.5Y 6/2) moist; massive; slightly sticky and nonplastic; few fine and medium roots; slightly acid; clear, smooth boundary. 6 to 9 inches thick.

IIB21t-14 to 29 inches, light brownish-gray (2.5Y 6/2) silty clay, grayish brown (2.5Y 5/2) moist; exterior of peds is white (2.5Y 8/2) and light brownish gray (2.5Y 6/2) moist; moderate, medium and fine, prismatic structure; hard, very firm, sticky and plastic; fine and medium roots; thin, continuous clay films on ped faces and in pores; medium acid; clear, smooth boundary. 12 to 16 inches thick.

IIB22t-29 to 43 inches, white (10YR 8/1) and pale-brown (10YR 6/3) silty clay, gray (10YR 6/1) and brown (10YR 5/3) moist; moderate, medium, subangular blocky structure; hard, firm, sticky and slightly plastic; common fine roots; thin patchy clay films in pores; few pebbles; few small sand pockets; slightly acid; clear, smooth boundary. 12 to 16 inches thick.

IIIC1-43 to 52 inches, light-gray (10YR 7/1) silt loam, gray (10YR 6/1) moist; few, 1/2 to 1-inch, irregular, pale brown (10YR 6/3) bands, brown (10YR 5/3) moist; massive; hard, firm, slightly sticky and slightly plastic; few roots; slightly acid; clear, smooth boundary. 6 to 10 inches thick.

IIIC2-52 to 60 inches, light-gray (10YR 7/1) silt loam, gray (10YR 6/1) moist; massive; hard, firm, slightly sticky and nonplastic; few roots; many, 1/32- to 1/2-inch, pale-brown (10YR 6/3) clay bands, brown (10YR 5/3) moist; slightly acid.

The content of coarse fragments between depths of 10 to 40 inches ranges from 0 to 10 percent. The IIB horizon above a depth of 40 inches is 38 to 50 percent clay. The A2 and Bir horizons are loam or silt loam. The IIB2t horizon is heavy silty clay loam to silty clay or clay. The C horizon is stratified silt loam, silty clay, clay, and very fine sand.

AnC-Anglen loam, 0 to 15 percent slopes. This nearly level to strongly sloping soil is on terraces. It has the profile described as representative of the series. Runoff is slow or medium, and the erosion hazard is slight or moderate. This soil is used for woodland, wildlife, and grazing. Capability unit IVe-2 nonirrigated ; woodland subclass 3o.

AnF-Anglen loam, 35 to 65 percent slopes. This steep to very steep soil is on terraces. Runoff is rapid or very rapid, and the erosion hazard is severe or very severe. This soil is used for woodland, wildlife, and grazing. Capability unit VIIe-1 nonirrigated; woodland subclass 3r.

Bamber Series

The Bamber series consists of well-drained, moderately steep to very steep soils underlain by andesite bedrock at a depth of 40 to 60 inches. These soils formed in volcanic ash and in material weathered from andesite. They are on uplands at elevations of 3,500 to 6,000 feet. The vegetation is mainly western larch and Douglas-fir. The annual precipitation is 25 to 35 inches. The mean annual air temperature is 39° to 41° F. The frost-free period is 90 to 110 days. Bamber soils are associated with Togo soils.

In a representative profile, a thin layer of organic litter is at the surface. Below this is 7 inches of light brownish-gray loam. Between depths of 7 and 18 inches is gravelly loam that is very pale brown in the upper part and pink in the lower part. This material is underlain by pink very gravelly loam that extends to fractured andesite bedrock at a depth of 42 inches.

Permeability is moderate. Available water capacity is low. Roots penetrate to bedrock.

Bamber soils are used as woodland and wildlife habitat. They also provide grazing.

Representative profile of Bamber loam in a forested area of Bamber-Rock land complex, 15 to 50 percent slopes, SW1/4 sec. 30, T. 38 N., R. 32 E., 50 yards east of Sheridan Road, one-fourth mile inside forest boundary:

O1-1 inch to 0, grass, leaves, needles, and twigs.

A2-0 to 7 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10R 4/2) moist; weak, fine, granular structure; soft, friable, nonsticky and nonplastic; many fine roots; slightly acid; clear, wavy boundary. 6 to 9 inches thick.

A&B-7 to 11 inches, very pale brown (10YR 7/4) gravelly loam, dark yellowish brown (10YR 4/4) moist; weak, medium and fine, granular structure; soft, friable, nonsticky and nonplastic; common fine roots; peds coated with clean sand grains; 20 percent angular gravel; slightly acid; clear, wavy boundary. 4 to 6 inches thick.

B2ir-11 to 18 inches, pink (7.5YR 7/4) gravelly loam, dark brown (7.5YR 4/4) moist; weak, medium and coarse, granular structure; soft, friable, nonsticky and nonplastic; common fine roots; 25 percent angular gravel; slightly acid; clear, wavy boundary. 6 to 8 inches thick.

IIB3-18 to 42 inches, pink (7.5YR 7/4) very gravelly loam, strong brown (7.5YR 5/6) moist; weak, medium and fine, angular blocky structure; soft, friable, nonsticky and nonplastic; common fine roots; 60 percent angular gravel; neutral; clear, wavy boundary. 20 to 32 inches thick.

IIIR-42 inches, fractured andesite bedrock.

The fine earth fraction above a depth of 40 inches is more than 60 percent volcanic ash and more than 35 percent coarse fragments by weighted average. Reaction ranges from medium acid to neutral, becoming less acid with increasing depth. Depth to andesite bedrock ranges from 40 to 60 inches. The A2 horizon is loam, silt loam, or very fine sandy loam and in places is gravelly or cobbly. The B2ir horizon is loam or silt loam and is either gravelly and cobbly or *very* gravelly and very cobbly. The B3 or C horizon is very gravelly or very cobbly loam and has a fine earth fraction that is dominantly volcanic ash.

BaE-Bamber loam, 15 to 35 percent slopes. This moderately steep to steep soil is on mountainsides. Runoff is medium or rapid, and the erosion hazard is moderate or severe. This soil is used as woodland and wildlife habitat. It also provides grazing. Capability subclass IVe nonirrigated; woodland subclass 4f.

BaF-Bamber loam, 35 to 65 percent slopes. This steep to very steep soil is on mountainsides and at terrace edges. Runoff is rapid or very rapid, and the erosion hazard is severe or very severe. The soil is used as woodland and wildlife habitat. Capability subclass VIIe nonirrigated; woodland subclass 4f.

BbE-Bamber-Rock land complex, 15 to 50 percent slopes. This moderately steep to very steep mapping unit is on mountainsides. It is 40 to 70 percent Bamber

loam and 30 to 60 percent Rock land. Rock land is described under the heading Rock land. The Bamber soil has the profile described as representative of the Bamber series. Runoff is medium to very rapid, and the erosion hazard is moderate to very severe. This mapping unit is used as woodland and wildlife habitat. It also provides grazing. Capability subclass VIIs nonirrigated; woodland subclass 4f for Bamber soil, 5x for Rock land.

BeE-Bamber-Tenas loamy, 15 to 50 percent slopes. This moderately steep to very steep mapping unit is on mountainsides. It is about 60 percent Bamber loam and 40 percent Tenas loam. The Tenas soil is described under the heading Tenas Series. Included in mapping are small areas of Edds soils. Runoff is medium to very rapid, and the erosion hazard is moderate to very severe. This mapping unit is used as wildlife habitat and woodland. It also provides grazing. Capability subclass VIe nonirrigated; woodland subclass 4f for Bamber soil, 4d for Tenas soil.

BlE-Bamber-Vallan loamy, 15 to 50 percent slopes. This moderately steep to very steep mapping unit is on mountainsides, It is 60 percent Bamber loam and 40 percent Vallan loam. The Vallan soil is described under the heading Vallan Series. Small areas of Tenas loam are included in mapping. Runoff is medium to very rapid, and the erosion hazard is moderate to very severe. This mapping unit provides grazing. It is also used as wildlife habitat and woodland. Capability subclass VIIe nonirrigated; woodland subclass 4f for Bamber soil, 5d for Vallan soil.

Bisbee Series

The Bisbee series consists of somewhat excessively drained, nearly level to steep sandy soils formed in glacial outwash reworked by wind. These soils are on terraces at elevations of 1,500 to 2,100 feet. In many places the surface is undulating or dunelike. The vegetation is mainly ponderosa pine, needlegrass, and pinegrass. The annual precipitation is 17 to 21 inches. The mean annual air temperature is about 46° F. The frost-free period is 110 to 130 days. Bisbee soils are associated with Dart, Hodgson, Scala, and Springdale soils.

In a representative profile, a thin layer of organic litter is at the surface. Below this is 28 inches of loamy fine sand that is grayish brown to a depth of 4 inches, pale brown to a depth of 9 inches, and light yellowish brown to a depth of 28 inches. The loamy fine sand is underlain by multicolored fine sand to a depth of 60 inches or more.

Permeability is rapid. Available water capacity is low. Roots penetrate to a depth of 60 inches or more.

Bisbee soils are used for woodland, wildlife, and grazing.

Representative profile of Bisbee loamy fine sand, 0 to 25 percent slopes, in grazed woodland 2,640 feet east and 1,320 feet south of the northwest corner of sec. 17, T. 36 N., R. 37 E.

O-1/2 inch to 0, undecomposed needles, twigs, and bark; abrupt, smooth boundary. 1/4 to 1 inch thick.

A1-0 to 4 inches, grayish-brown (10YR 5/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak, fine, granular structure; soft, very friable, nonsticky and nonplastic; common fine and very fine roots; neutral; clear, smooth boundary. 4 to 9 inches thick.

C1-4 to 9 inches, pale-brown (10YR 6/3) loamy fine sand, dark grayish brown (2.5Y 4/2) moist; massive; loose, nonsticky and nonplastic; common fine roots; neutral; clear, smooth boundary. 5 to 15 inches thick.

C2-9 to 28 inches, light yellowish-brown (2.5YR 6/4) loamy fine sand, olive brown (2.5Y 4/4) moist; single grained; loose, nonsticky and nonplastic; few fine roots; few, fine, faint iron stains on sand particles ; neutral ; gradual, wavy boundary. 15 to 20 inches thick.

C3-28 to 60 inches, multicolored fine sand; single grained; loose; few roots; neutral.

The content of mica is appreciable. Reaction is neutral to slightly acid. In places there is a thin A2 horizon.

BmD-Bisbee loamy fine sand, 0 to 25 percent slopes. This nearly level to moderately steep soil is on terraces. It has the profile described as representative of the series. Included in mapping are small areas of steep Bisbee soils and small areas of Dart and Springdale soils. Runoff is slow, the erosion hazard is slight, and the hazard of soil blowing is moderate. This soil is used for woodland, grazing and dryfarmed alfalfa. Capability unit IVs-3 nonirrigated, IVs-1 irrigated; woodland subclass 2s.

BmE-Bisbee loamy fine sand, 25 to 45 percent slopes. This steep soil is on terraces. It has a profile similar to the one described as representative of the series, but in places the 4-inch surface layer is lacking and the yellowish-brown underlying material is exposed. Runoff is medium, and the hazard of erosion is moderate. The hazard of soil blowing is moderate. All the acreage is used for grazing and woodland. Capability unit VIs-1 nonirrigated; woodland subclass 2s.

Bisbee Variant

This variant of the Bisbee series consists of somewhat excessively drained, nearly level to moderately steep soils formed in wind-worked glacial lake deposits. These soils are on terraces at elevations of 1,500 to 2,500 feet. The vegetation is mainly ponderosa pine, needlegrass, and pinegrass. The annual precipitation is 18 to 21 inches. The mean annual air temperature is 43° to 46° F. The frost-free period is 100 to 130 days. This dark-colored variant is associated with Chesaw and Bisbee soils.

In a representative profile, the upper 16 inches is dark grayish-brown loamy sand. Between 16 and 28 inches is pale-brown loamy sand. From 28 to 60 inches or more is light brownish-gray sand and light-gray fine sand.

Permeability is rapid. Available water capacity is moderate. Most roots penetrate only to the sand.

These soils are used for grazing, dryland alfalfa, and irrigated alfalfa and grass.

Representative profile of Bisbee loamy sand, dark surface variant, 0 to 25 percent slopes, 290 feet east and 270 feet south of the northwest corner of sec. 9, T. 40 N., R. 34E.

Ap-0 to 6 inches, dark grayish-brown (10YR 4/2) loamy sand, very dark brown (10YR 2/2) moist; weak, fine and medium, granular structure; soft, very friable, nonsticky and nonplastic; common fine and very fine roots; neutral; clear, smooth boundary. 5 to 7 inches thick.

A12-6 to 16 inches, dark grayish-brown (10YR 4/2) loamy sand, very dark brown (10YR 2/2) moist; weak, medium, subangular blocky structure; soft, very friable, nonsticky and nonplastic; common fine and very fine roots; neutral; clear, smooth boundary. 7 to 13 inches thick.

AC-16 to 28 inches, pale-brown (10YR 6/3) loamy sand, brown or dark brown (10YR 4/3) moist; massive; soft, very friable, nonsticky and nonplastic; common very fine roots; neutral; clear, smooth boundary. 8 to 16 inches thick.

C1-28 to 40 inches, light brownish-gray (2.5Y 6/2) sand, dark grayish brown (2.5Y 4/2) moist; single grained; loose, nonsticky and plastic; few very fine roots; neutral; gradual, smooth boundary. 10 to 24 inches thick.

C2-40 to 60 inches, light-gray (2.5Y 7/2) fine sand, grayish brown (2.5Y 5/2) moist; single grained; few very fine roots; neutral.

The A1 horizon is dark grayish brown or dark brown and is 12 to 20 inches thick. The AC horizon is pale brown or yellowish brown. In places the C horizon contains fine gravel.

BsD-Bisbee loamy sand, dark surface variant, 0 to 25 percent slopes. This nearly level to moderately steep soil is on terraces. It has the profile described as representative of the variant. Included in mapping are some areas where the slope is more than 25 percent and small areas of Chesaw soils. Runoff is slow, and the erosion hazard is slight. This soil is used mainly as woodland and wildlife habitat. A small acreage is used for grazing and irrigated alfalfa and grass. Capability unit IVs-3 nonirrigated, IVs-1 irrigated; woodland subclass 2s.

Cedonia Series

The Cedonia series consists of well-drained, nearly level to steep soils formed in calcareous glacial lake sediments, including volcanic ash. These soils are on terraces and terrace edges at elevations of 1,350 to 2,000 feet. The vegetation is mainly ponderosa pine and bluebunch wheatgrass. The annual precipitation is 18 to 21 inches. The mean annual air temperature is about 47° F. The frost-free period is 110 to 130 days. Cedonia soils are associated with Bisbee, Hodgson, and Scala soils.

In a representative profile, the uppermost 24 inches is light brownish-gray silt loam that is calcareous in the lower part. Between depths of 24 and 60 inches is light-gray silt loam that is calcareous around pores and between laminations.

Permeability is moderate. Available water capacity is high. Roots penetrate, mostly along cleavage planes, to a depth of about 34 inches.

Cedonia soils are used for grain, grasses, legumes, grazing, woodland, and wildlife.

Representative profile of Cedonia silt loam, 0 to 5 percent slopes, 2,112 feet south and 1,848 feet east of the northwest corner of sec. 17, T. 35 N., R. 37 E.

A1-0 to 3 inches, light brownish-gray (10YR 6/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak, thick, platy structure; slightly hard, very friable, slightly sticky and plastic; many roots; neutral; abrupt, smooth boundary. 2 to 5 inches thick.

A3-3 to 11 inches, light brownish-gray (10YR 6/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak, fine, subangular blocky structure parting to weak, fine, granular; slightly hard, friable, slightly sticky and plastic; many roots; moderately alkaline; clear, wavy boundary. 3 to 8 inches thick.

B2-11 to 17 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; moderate, medium, subangular blocky structure; slightly hard, friable, slightly sticky and plastic; many roots; common fine pores; moderately alkaline; abrupt, smooth boundary. 6 to 11 inches thick.

C1-17 to 24 inches, light brownish-gray (2.5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) moist; weak, medium, platy structure; slightly hard, friable, sticky and plastic; few roots; calcium carbonate in pores; strongly alkaline; abrupt, wavy boundary. 6 to 12 inches thick.

C2-24 to 34 inches, light-gray (2.5Y 7/2) silt loam, olive gray (5Y 5/2) moist; medium to finely laminated; hard, firm, sticky and plastic; few roots; common very fine pores; calcium carbonate in pores and between laminations; strongly alkaline; abrupt, smooth boundary. 8 to 12 inches thick.

C3-34 to 60 inches, light-gray (2.5Y 7/2) silt loam, olive (5Y 5/3) moist; massive; hard, firm, sticky and plastic; few very fine pores; distinct stains around pores, yellowish brown (10YR 5/6) moist; calcium carbonate in pores; moderately alkaline.

The A horizon when moist is very dark grayish brown or dark grayish brown. It is silt loam or very fine sandy loam. The structure of the B horizon ranges from weak to moderate.

CdB-Cedonia silt loam, 0 to 5 percent slopes. This is a nearly level to gently sloping soil on terraces. It has the profile described as representative of the series. Included in mapping are areas of Scala and Bisbee soils, which make up about 5 percent of this unit. Runoff is very slow or slow, and the erosion hazard is slight. This soil is used for alfalfa, grass, small grain, woodland, and wildlife. Capability unit IIIe-2 nonirrigated, IIIe-3 irrigated; woodland subclass 3o.

CdE-Cedonia silt loam, 15 to 35 percent slopes. This is a moderately steep to steep soil on remnants of terraces. It has a profile similar to the one described as representative of the series, but the dark-colored surface layer is 5 to 7 inches thinner and lime is nearer the surface. Included in mapping are small areas of Bisbee and Scala soils. Runoff is medium or rapid, and the erosion hazard is moderate or severe. This soil is used as woodland and wildlife habitat. Capability unit IVe-3 nonirrigated; woodland subclass 3o.

Chesaw Series

The Chesaw series consists of somewhat excessively drained, nearly level to very steep soils formed in glacial outwash that included volcanic ash in the upper part. These soils occupy terraces and eskers at elevations of 1,800 to 3,000 feet. The vegetation is mainly bluebunch wheatgrass, needlegrass, rough fescue, Sandberg bluegrass, and scattered ponderosa pine. The annual precipitation is 14 to 17 inches. The mean annual air temperature is about 43° F. The frost-free period is 100 to 120 days. Chesaw soils are associated with Mires, Molson, and Republic soils.

The uppermost 18 inches in a representative profile is gravelly loamy sand that is dark gray in the upper part and brown in the lower part. Beneath this to a depth of 60 inches or more is dark-gray and grayishbrown gravelly sand.

Permeability is rapid. Available water capacity is low or very low. Roots penetrate to a depth of 14 to 20 inches.

Chesaw soils are used mainly for grazing. Some areas are used as cabin sites.

Representative profile of Chesaw gravelly loamy sand, 15 to 45 percent slopes, in grassland 140 feet east and 460 feet north of the southwest corner of NE1/4NE1/4 sec. 20, T. 37 N., R. 33 E.

A11-0 to 1 inch, dark-gray (10YR 4/1) gravelly loamy sand, black (10YR 2/1) moist; weak, fine, granular structure; soft, very friable, nonplastic and nonsticky; many roots; neutral; abrupt, smooth boundary. 1 to 3 inches thick.

A12-1 to 12 inches, dark-gray (10YR 4/1) gravelly loamy sand, black (10YR 2/1) moist; massive; soft, very friable; many roots; neutral; clear, smooth boundary. 8 to 14 inches thick.

AC-12 to 18 inches, brown (10YR 5/3) gravelly loamy sand, dark brown (10YR 3/3) moist; massive; loose, nonplastic and nonsticky; common roots; 40 percent coarse fragments; neutral; clear, smooth boundary. 5 to 7 inches thick.

C-18 to 60 inches, dark-gray (10YR 4/1) and grayishbrown (10YR 5/2) gravelly sand, black (10YR 2/1) and very dark grayish brown (10YR 3/2) moist; 40 percent gravel by volume; neutral.

Reaction ranges from neutral to slightly acid. The content of coarse fragments between a depth of 10 and 40 inches ranges from 25 to 50 percent, but averages more than 35 percent. The Al horizon is gravelly loamy sand or sandy loam. The AC horizon is gravelly loamy sand or gravelly coarse sandy loam.

CeE-Chesaw gravelly loamy sand, 15 to 45 percent slopes. This is a moderately steep to steep soil on the sides of terraces and eskers. It has the profile described as representative of the series. Included in mapping are areas of Mires soils, other Chesaw soils, and nongravelly sandy soils, all of which make up about 15 percent of this unit. Runoff is medium, and the erosion hazard is moderate. Available water capacity is very low. The entire acreage is used for grazing. Capability unit VIs-1 nonirrigated; Benchland range site.

CeF-Chesaw gravelly loamy sand, 45 to 65 percent slopes. This is a very steep soil on eskers and terrace escarpments. It has a profile similar to the one described as representative of the series, but the dark-gray upper layer is only 7 to 10 inches thick and the depth to gravelly sand is 14 to 16 inches. Included in mapping are areas of other Chesaw soils and nongravelly sandy soils, which make up about 10 percent of this unit. Runoff is rapid, and the erosion hazard is severe. Available water capacity is very low. The entire acreage is used for grazing. Capability unit Vlls-1 nonirrigated ; Benchland range site.

ChA-Chesaw sandy loam, 0 to 3 percent slopes. This is a nearly level soil on terraces and old alluvial fans. It has a profile similar to the one described as representative of the series, but the dark-gray upper layers differ in texture. Included in mapping are small areas of Mires and Republic soils. Runoff is very slow, and the hazard of erosion is slight. Available water capacity is low. The entire acreage is used for grazing and hay. A small acreage is irrigated. Capability unit IVs-1 nonirrigated, IIIs-1 irrigated; Benchland range site.

ChC-Chesaw sandy loam, 3 to 15 percent slopes. This is a gently to strongly sloping soil on terraces and old alluvial fans. It has a profile similar to the one described as representative of the series, but the dark-gray upper layers differ in texture. Runoff is slow or medium, and the erosion hazard is slight or moderate. Available water capacity is low. The entire acreage is used for grazing and hay. Capability unit IVe-1 nonirrigated, IIIe-1, irrigated; Benchland range site.

ClE-Chesaw stony sandy loam, 0 to 45 percent slopes. This is a nearly level to steep soil on the sides of terraces. It has a profile similar to the one described as representative of the series, but the upper 12 to 18 inches is sandy loam that is less than 25 percent gravel. Scattered surface stones and cobbles are 45 to 65 feet apart. In some small areas they are 10 to 20 feet apart. Runoff is slow to rapid. The erosion hazard is slight to severe. Available water capacity is low. All the acreage is used for grazing. Capability unit VIe-3 nonirrigated; Benchland range site.

Cobey Series

The Cobey series consists of well-drained, moderately steep to steep soils formed in volcanic ash overlying glacial till. These soils are on uplands at elevations of 2,800 to 5,000 feet. The vegetation is mainly Douglas-fir, ponderosa pine, subalpine fir, and lodgepole pine. The annual precipitation is 20 to 30 inches. The mean annual air temperature is about 41° F. The frost-free period is 90 to 120 days. Cobey soils are associated with Pepoon and Oxerine soils.

The uppermost 26 inches in a representative profile is silt loam that in sequence downward is gray, grayish brown, and brown. Between depths of 26 and 42 inches is brown loam. This layer is underlain by pale-brown very gravelly fine sandy loam to a depth of 60 inches or more.

Permeability is moderate. Available water capacity is high. Roots penetrate to a depth of 60 inches or more. Cobey soils are used as woodland and wildlife habitat.

Representative profile of Cobey silt loam. 15 to 35 percent slopes, in a forested area, SE1/4SE1/4NW1/4 sec. 31, T. 37 N., R. 37 E., near switchback on forest road:

A11-0 to 5 inches, gray (10YR 5/1) silt loam, black (10YR 2/1) moist; moderate, fine, granular structure; soft, friable, nonsticky and nonplastic; many, fine, medium and coarse roots; few fine pebbles; slightly acid; clear, smooth boundary. 3 to 8 inches thick.

A12-5 to 11 inches, grayish-brown (10YR 5/2) silt loam, very dark brown (10YR 2/2) moist; weak, fine, subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; common fine and medium roots; few fine tubular pores; 5 percent gravel; medium acid; clear, smooth boundary. 4 to 10 inches thick.

A13-11 to 15 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak, fine, subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; common fine and medium roots; few fine tubular pores; 5 percent gravel ; neutral ; clear, smooth boundary. 3 to 8 inches thick.

A3-15 to 26 inches. brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; weak. fine and medium, subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; common medium roots; few fine tubular pores; 8 percent gravel; neutral; clear, smooth boundary. 8 to 14 inches thick.

B2-26 to 42 inches, brown (10YR 5/3) loam, dark yellowish brown (10YR 3/4) moist; weak, fine and medium, subangular blocky structure; slightly hard,

friable, nonsticky and nonplastic; common medium roots; few fine tubular pores; 10 percent gravel; neutral; clear, smooth boundary. 12 to 18 inches thick.

IIC-42 to 60 inches, pale-brown (10YR 6/3) very gravelly fine sandy loam, brown (10YR 5/3) moist; massive; slightly hard, friable, slightly sticky and nonplastic; common medium roots; few fine tubular pores; 50 percent gravel and cobbles; neutral.

Between depths of 10 and 40 inches, the soil is more than 60 percent volcanic ash and less than 15 percent coarse fragments by weighted average. Reaction ranges from medium acid to neutral. The A horizon is silt loam or loam. The B2 horizon is loam or silt loam. The IIC horizon is fine sandy loam or very fine sandy loam and is gravelly or very gravelly.

CoE-Cobey silt loam, 15 to 35 percent slopes. This is a moderately steep to steep soil on mountainsides. It has the profile described as representative of the series. Included in mapping are small areas of Edds, Tenas, and Vallan soils. Runoff is medium or rapid, and the erosion hazard is moderate or severe. This soil is used as woodland and wildlife habitat. Capability subclass We nonirrigated; woodland subclass 3o.

Colluvial Land

Cu-Colluvial land is fragmented, unconsolidated rock material. It generally occurs on steep talus slopes and is unstable. Some fine particles are mixed with cobbles, stones, and boulders. In most areas, the only plant cover is a few Douglas-fir or ponderosa pine trees and very little understory vegetation. Included in mapping are escarpments and a few recent slump areas adjacent to Lake Roosevelt. Colluvial land is used as wildlife habitat. Capability unit VIIIs-1 nonirrigated.

Dart Series

The Dart series consists of somewhat excessively drained, nearly level to steep soils formed in sandy material deposited by water. These soils occupy terraces and terrace edges at elevations of 1,400 to 2,800 feet. The vegetation is mainly ponderosa pine, prairie junegrass, and needlegrass. The annual precipitation is 17 to 21 inches. The mean annual air temperature is about 46° F. The frost-free period is 100 to 130 days. Dart soils are associated with Bisbee, Scala, and Springdale soils.

In a representative profile, the uppermost 14 inches is coarse sandy loam that is dark grayish brown in the upper part and brown in the lower part. Between depths of 14 and 19 inches is pale-brown loamy coarse sand. This layer is underlain by multicolored sand to a depth of 60 inches or more.

Permeability is rapid. Available water capacity is low. Roots penetrate to a depth of 60 inches or more.

Dart soils are used for grass, alfalfa, grain, grazing, and woodland. They also provide building sites.

Representative profile of Dart coarse sandy loam, 0 to 5 percent slopes, in grazed woodland 1,452 feet south of northwest corner of sec. 9, T. 35 N., R. 37 E.

A1-0 to 6 inches, dark grayish-brown (10YR 4/2) coarse sandy loam, very dark brown (10YR 2/2) moist; - weak, thick, platy structure; soft, very friable, nonsticky and nonplastic; common fine roots; slightly acid; abrupt, smooth boundary. 4 to 8 inches thick.

B2t-6 to 14 inches, brown (10YR 5/3) coarse sandy loam, dark brown (10YR 3/3) moist; weak, very thick, platy structure; dense, brittle; slightly hard, very friable, nonsticky and nonplastic; common fine roots; sand grains bridged with clay and fine silt; slightly acid; clear, wavy boundary. 4 to 8 inches thick.

C1-14 to 19 inches, pale-brown (10YR 6/3) loamy coarse sand, dark grayish brown (10YR 4/2) moist; single grained; soft, very friable, nonsticky and nonplastic; few roots; neutral; clear, wavy boundary. 5 to 7 inches thick.

C2-19 to 60 inches, multicolored sand; single grained; few roots; 2 percent fine gravel; neutral.

Between depths of 10 and 40 inches the texture is coarser than loamy very fine sand. Reaction is slightly acid to neutral. The A horizon is less than 1 percent organic matter. It ranges from loamy coarse sand to coarse sandy loam. The C horizon is loamy coarse sand or sand.

DaB-Dart coarse sandy loam, 0 to 5 percent slopes. This is a nearly level to gently sloping soil on terraces. It has the profile described as representative of the series. Included in mapping are small dunes of Bisbee loamy fine sand, 0 to 25 percent slopes. Runoff is very slow or slow, and the erosion hazard is slight. This soil is used for grazing, small grain, alfalfa, grass, and woodland. Capability unit IVs-3 nonirrigated, IVs-1 irrigated; woodland subclass 5s.

DaE-Dart coarse sandy loam, 5 to 45 percent slopes. This gently sloping to steep soil is on narrow terraces and on terrace sides. It has a profile similar to the one described as representative of the series, but the dark grayish-brown surface layer is less than 4 inches thick and ranges from sandy loam to loamy sand. A few small areas of Chesaw soils are included in mapping. Runoff is slow to rapid, and the erosion hazard is slight to severe. This soil is used for grass, alfalfa, grain, grazing, and woodland. It is also used as building sites. Capability unit VIe-2 nonirrigated; woodland subclass 5s.

Donavan Series

The Donavan series consists of well-drained, nearly level to very steep soils formed in volcanic ash overlying glacial till. These soils are on uplands at elevations of 1,800 to 4,000 feet. The vegetation is mainly ponderosa pine, rough fescue, and bluebunch wheatgrass. The annual precipitation is 14 to 18 inches. The mean annual air temperature is about 43° F. The frost-free period is 90 to 120 days. Donavan soils are associated with Molson, Nevine, and Vallan soils.

In a representative profile, a thin layer of organic litter is at the surface. Below this is 14 inches of loam that is grayish brown in the upper part and brown in the lower part. The underlying material to a depth of 60 inches or more is gravelly loam that is pale yellow above a depth of 28 inches and light gray below.

Permeability is moderate. Available water capacity is moderate or moderately high. Root penetration is deep.

Donavan soils are used for grazing, woodland, and wildlife.

Representative profile of Donavan loam, 0 to 8 percent slopes, in a forested area 925 feet south and 925 feet west of the northeast corner of sec. 21, T. 36 N., R. 37 E.

O1-1 inch to 0, needles and twigs.

A1-0 to 7 inches, grayish-brown (10YR 5/2) loam, very dark brown (10YR 2/2) moist; weak, very fine and fine, granular structure; soft, very friable, nonsticky and slightly plastic; many very fine and fine roots; 2 percent gravel by volume; slightly acid; clear, wavy boundary. 5 to 9 inches thick.

B2-7 to 14 inches, brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; weak, fine, subangular blocky structure; soft, very friable, nonsticky and slightly plastic; many fine and very fine roots; 2 percent gravel by volume; slightly acid; abrupt, wavy boundary. 7 to 20 inches thick.

IIC1-14 to 28 inches, pale-yellow (2.5Y 7/4) gravelly loam, olive brown (2.5Y 4/4) moist; few, fine, distinct streaks, strong brown (7.5YR 5/6) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine and medium roots; 25 percent gravel and cobbles by volume; neutral; gradual, wavy boundary. 10 to 20 inches thick.

IIC2-28 to 60 inches, light-gray (2.5Y 7/2) gravelly loam, light olive brown (2.5Y 5/4) moist; massive; hard, firm, slightly sticky and slightly plastic; few fine and medium roots; 25 percent gravel and cobbles by volume; neutral.

The content of gravel, cobbles, and stones between depths of 10 and 40 inches ranges from 10 to 35 percent by volume. This section is less than 18 percent clay, and the upper part is more than 60 percent pyroclastic material. Reaction ranges from slightly acid to neutral. The A horizon is silt loam or loam. The B horizon ranges from loam to silt loam and in places is gravelly or cobbly. The C horizon ranges from loam to sandy loam and in places is gravelly or cobbly.

DnB-Donavan loam, 0 to 8 percent slopes. This is a nearly level to gently sloping soil on terraces. It has the profile described as representative of the series. Runoff is very slow or slow, and the erosion hazard is slight. This soil was formerly cultivated, but is now used for grazing. Capability unit IIIe-1 nonirrigated; woodland subclass 4o.

DnD-Donavan loam, 8 to 30 percent slopes. This is a strongly sloping to steep soil on uplands. Included in mapping are small areas of Molson loam, Donavan stony loam, and Nevine loam. Runoff is medium or rapid, and the erosion hazard is moderate or severe. This soil is used for grazing, woodland, and wildlife. Capability unit IVe-2 nonirrigated; woodland subclass 4o.

DnF-Donavan loam, 30 to 65 percent slopes. This is a steep to very steep soil on terrace slopes and at terrace edges. Runoff is rapid or very rapid, and the erosion hazard is severe or very severe. This soil is used for grazing, woodland, and wildlife. Capability unit VIe-2 nonirrigated; woodland subclass 4r.

DoD-Donavan stony loam, 0 to 25 percent slopes. This is a nearly level to moderately steep soil on uplands. It has a profile similar to the one described as representative of the series, but stones and cobbles cover up to 6 percent of the surface area. In places there is 2 or 3 inches of dark-gray loam above the grayish-brown loam surface layer. Runoff is slow or medium, and the erosion hazard is slight or moderate. This soil is used as woodland and wildlife habitat. It also provides grazing. Capability unit VIe-2 nonirrigated; woodland subclass 4o.

DoF-Donavan stony loam, 25 to 65 percent slopes. This is a steep to very steep soil on south-facing slopes. It has a profile similar to the one described as representative of the series, but the surface layer is only about 5 inches thick and 1 to 4 percent of the surface area is covered with stones. About 10 percent of the total acreage of this mapping unit is included areas of Rock land, 6 percent Molson stony loam, and 6 percent Nevine stony loam. Also included are small areas of Pepoon soils. Runoff is rapid or very rapid, and the erosion hazard is severe or very severe. The soil is used as woodland and wildlife habitat. It also provides grazing. Capability unit VIIe-1 nonirrigated; woodland subclass 4r.

DrE-Donavan-Rock land complex, 15 to 50 percent slopes. This moderately steep to steep mapping unit is 40 percent Donavan stony loam, 30 percent Rock land, 15 percent Nevine stony loam, and 15 percent small areas of Colluvial land and Pepoon and Vallan soils. The Donavan soil has a profile similar to the one described as representative of the series, but stones cover 1 to 6 percent of the surface area. Runoff is medium or very rapid, and the erosion hazard is moderate or severe. This mapping unit is used as woodland and wildlife habitat. It also provides grazing. Capability unit VIIs-1 nonirrigated ; woodland subclass 4r for Donavan soil, 5x for Rock land.

Edds Series

The Edds series consists of well-drained, moderately steep and very steep soils formed in volcanic ash overlying glacial till. These soils are on uplands at elevations of 3,500 to 6,000 feet. The vegetation is mainly ponderosa pine and Douglas-fir. The annual precipitation is 20 to 30 inches. The mean annual air temperature is 38° to 42° F. The frost-free period is 80 to 100 days. Edds soils are associated with Growden, Tenas, Leonardo, and Manley soils.

In a representative profile, the uppermost 17 inches is loam that is dark gray in the upper 6 inches, grayish brown in the next 6 inches, and very pale brown in the lower 5 inches. Next, in sequence downward, is 7 inches of light yellowish-brown clay loam, 4 inches of light brownish-gray silt loam, and 12 inches of light-gray gravelly loamy coarse sand. Below this to a depth of 60 inches or more is grayish-brown loam.

Permeability is moderate. Available water capacity is high. Roots penetrate to a depth of 28 inches or more.

Edds soils are used for grazing, woodland, and wildlife.

Representative profile of Edds loam, 15 to 35 percent slopes, under grass and shrubs, NE1/4SW1/4 sec. 7, T. 35 N., R. 34 E. In the Block Floor Cabin area, 20 yards north of road, 300 yards east of spring, Colville National Forest:

A1-0 to 6 inches, dark-gray (10YR 4/1) loam, black (10YR 2/1) moist; weak, fine and medium, granular and medium subangular blocky structure; soft, friable, slightly sticky and slightly plastic; many fine roots; 15 percent fine gravel; slightly acid; abrupt, smooth boundary. 4 to 6 inches thick.

A3-6 to 12 inches, grayish-brown (10YR 5/2) loam, very dark brown (10YR 2/2) moist; moderate, fine and medium, subangular blocky structure; slightly hard, firm, slightly sticky and slightly plastic; many fine roots; 15 percent fine gravel; slightly acid; clear, wavy boundary. 6 to 9 inches thick.

B1-12 to 17 inches, very pale brown (10YR 7/3) loam, dark brown (10YR 4/3) moist; moderate, medium and fine, subangular blocky structure; slightly hard, firm, sticky and slightly plastic; many fine

roots; 15 percent fine gravel; medium acid; clear, wavy boundary. 5 to 7 inches thick.

B2-17 to 24 inches, light yellowish-brown (10YR 6/4) clay loam, dark yellowish brown (10YR 4/4) moist; moderate, medium and coarse, angular blocky structure; slightly hard, firm, sticky and slightly plastic; many fine roots; many tubular pores; thin, patchy clay films in pores and sand grains bridged with clay; 5 percent gravel; slightly acid; clear, wavy boundary. 6 to 9 inches thick.

IIC1-24 to 28 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; single grained; loose; friable, slightly sticky and nonplastic; many fine roots; slightly acid; clear, wavy boundary. 3 to 6 inches thick.

IIIC2-28 to 40 inches, light-gray (10YR 7/2) gravelly loamy coarse sand, grayish brown (10YR 5/2) moist; massive; hard, firm, nonsticky and nonplastic ; many tubular pores ; many clean sand grains ; slightly acid; gradual, irregular boundary. 10 to 15 inches thick.

IVC3-40 to 60 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; strong, medium, platy structure; hard, very firm, sticky and plastic; sand grains bridged with clay; slightly acid.

Reaction ranges from medium acid to slightly acid. The dark-colored surface layer is 10 to 15 inches thick. The A horizon ranges from loam to silt loam. The B2 horizon ranges from loam to clay loam. The upper part of the C horizon ranges from silt loam or loam to loamy coarse sand and in places is gravelly. It is single grained or massive. The lower part of the C horizon ranges from loam or silt loam to sandy loam and has moderate to strong, platy or blocky structure.

EdE-Edds loam, 15 to 35 percent slopes. This moderately steep to steep soil is on mountainsides. It has the profile described as representative of the series. Runoff is medium or rapid, and the erosion hazard is moderate or severe. This soil is used for grazing, wildlife, and woodland. Capability subclass IVe nonirrigated; woodland subclass 3o.

EdF-Edds loam, 35 to 65 percent slopes. This is a steep to very steep soil on mountainsides. A few small areas of Togo soils are included in mapping. Runoff is rapid or very rapid, and the erosion hazard is severe or very severe. This soil is used for grazing, wildlife, and woodland. Capability subclass VIe nonirrigated; woodland subclass 3r.

EoE-Edds-Oxerine loamy, 15 to 50 percent slopes. This moderately steep to very steep mapping unit is on mountainsides. It is about 60 percent Edds loam and 40 percent Oxerine loam. The Oxerine soil is described under the heading Oxerine Series. Runoff is medium to very rapid, and the erosion hazard is moderate to very severe. This mapping unit is used for grazing, woodland, and wildlife. Capability subclass VIe nonirrigated; woodland subclass Sr for Edds soil, 3d for Oxerine soil.

ErE-Edds-Rock land complex, 15 to 50 percent slopes. This moderately steep to very steep mapping unit is 40 to 70 percent Edds soil and 30 to 60 percent Rock land. The Rock land is 50 to 90 percent rock outcrop and 10 to 50 percent very shallow soils. Runoff is medium to very rapid, and the erosion hazard is moderate to very severe. This mapping unit is used for grazing, wildlife, and woodland. Capability subclass VIIs nonirrigated; woodland subclass 3r for Edds soil, 5x for Rock land.

Gahee Series

The Gahee series consists of well-drained, nearly level to very steep soils underlain by very coarse sand below a depth of about 2 to 3 feet. These soils formed in volcanic ash overlying glacial outwash. They are on terraces and terrace edges at elevations of 4,000 to 6,500 feet. The vegetation is mainly Douglas-fir, subalpine fir, lodgepole pine, western larch, and red alder. The annual precipitation is about 35 inches. The mean annual air temperature is about 39° F. The frost-free period is about 75 to 95 days. Gahee soils are associated with Manley, Scar, and Togo soils.

In a representative profile, a thin layer of organic litter is at the surface. Next, in sequence downward, is 3 inches of pinkish-white very fine sandy loam, 16 inches of light-brown loam, and 12 inches of white sandy loam. The underlying material to a depth of 60 inches or more is very pale brown very coarse sand.

Permeability is moderately rapid. Available water capacity is moderate or moderately high. Roots penetrate to a depth of 31 inches or more.

Gahee soils are used for woodland, wildlife, and grazing.

Representative profile of Gahee loam, 0 to 15 percent slopes, in a forested area, SE1/4NE1/4 sec. 8, T. 35 N., R. 35 E., on logging spur on south side of south fork of Sherman Creek, one-half mile west of Barnaby Creek Road:

O1-1 to 1/2 inch, leaves, needles, and twigs.

O2-1/2 inch to 0, decomposed leaves, needles, and twigs.

A2-0 to 3 inches, pinkish-white (7.5YR 8/2) very fine sandy loam, brown (7.5YR 5/3) moist; weak, fine and medium, subangular blocky structure; soft, friable, nonsticky and nonplastic; many fine roots; neutral; abrupt, smooth boundary. 2 to 4 inches thick.

B2ir-3 to 19 inches, light-brown (7.5YR 6/4) loam, brown (7.5YR 4/4) moist; weak, fine and medium, subangular blocky structure; soft, friable, nonsticky and nonplastic; many fine roots, with root mat at lower boundary; slightly acid; abrupt, wavy boundary. 14 to 18 inches thick.

IIC1-19 to 31 inches, white (N 8/0) sandy loam, light gray (N 7/0) moist; massive; slightly hard, slightly firm, slightly sticky and nonplastic; few medium roots; neutral; abrupt, wavy boundary. 10 to 14 inches thick.

IIIC2-31 to 60 inches, very pale brown (10YR 8/3) very coarse sand, pale brown (10YR 6/3) moist; massive; loose, friable, nonsticky and nonplastic; neutral.

Reaction is slightly acid or neutral. The content of coarse fragments ranges from 0 to 10 percent. The A2 horizon ranges from very fine sandy loam to loam or silt loam. The B2 horizon ranges from loam or silt loam to very fine sandy loam. The IIC1 horizon ranges from sandy loam to loamy sand.

GaC Gahee loam, 0 to 15 percent slopes. This is a nearly level to strongly sloping soil on terraces. It has the profile described as representative of the series. Runoff is slow or medium, and the erosion hazard is slight or moderate. This soil is used for woodland, wildlife, and limited grazing. Capability subclass IVe nonirrigated; woodland subclass 2o.

GaE-Gahee loam, 15 to 35 percent slopes. This is a moderately steep to steep soil in basins and at terrace edges. Runoff is medium or rapid, and the erosion hazard is moderate or severe. This soil is used for

woodland, wildlife, and limited grazing. Capability subclass IVe nonirrigated; woodland subclass 3o.

GaF-Gahee loam, 35 to 65 percent slopes. This is a steep to very steep soil at terrace edges. Runoff is rapid or very rapid, and the erosion hazard is severe or very severe. This soil is used for woodland, wildlife, and limited grazing. Capability subclass VIe nonirrigated; woodland subclass 3r.

Goddard Series

The Goddard series consists of well-drained, nearly level to very steep soils underlain by very gravelly coarse sand below a depth of 18 to 33 inches. These soils formed in volcanic ash overlying glacial till. They are on terraces and terrace edges at elevations of 1,800 to 3,500 feet. The vegetation is mostly Douglas-fir, ponderosa pine, and larch. The annual precipitation is 16 to 19 inches. The mean annual air temperature is about 42° F. The frost-free period is 90 to 120 days. Goddard soils are associated with Anglen, Merkel, and Nevine soils.

In a representative profile, a thin layer of organic litter is at the surface. Below this is 13 inches of silt loam. The upper quarter of an inch is gray, the next 43/4 inches is brown, and the lower 8 inches is pale brown. Between depths of 13 and 24 inches is pale-brown gravelly coarse sandy loam. This layer is underlain by very gravelly coarse sand to a depth of 60 inches or more.

Permeability is moderate and moderately rapid to a depth of 24 inches and very rapid below. Available water capacity is low. Roots penetrate to a depth of about 24 inches.

Goddard soils are used for woodland, wildlife, and grazing.

Representative profile of Goddard silt loam, 0 to 5 percent slopes, in woodland 150 feet east and 800 feet south of the northwest corner of NE1/4NW1/4 sec. 9, T. 36 N., R. 32 E.

O1-1 inch to 0, partly decomposed needles and twigs.

A2-0 to 1/4 inch, gray (10YR 6/1) silt loam, very dark gray (10YR 3/1) moist; weak, medium, granular structure; soft, very friable, nonsticky and nonplastic; slightly acid; abrupt, smooth boundary. 0 to 1 inch thick.

B21-1/4 inch to 5 inches, brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; weak, medium, subangular blocky structure; soft, very friable, nonsticky and slightly plastic; many roots; common fine pores; 15 percent gravel by volume; slightly acid; clear, smooth boundary. 2 to 8 inches thick.

B22-5 to 13 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; weak, medium, subangular blocky structure; soft, very friable, nonsticky and slightly plastic; many roots; common fine pores; 15 percent gravel by volume; slightly acid; clear, smooth boundary. 6 to 15 inches thick.

IIC1-13 to 24 inches, pale-brown (10YR 6/3) gravelly coarse sandy loam, brown (10YR 4/3) moist; many, medium, distinct mottles, dark yellowish brown (10YR 4/4) moist; massive; soft, very friable, nonsticky and nonplastic; many roots; 30 percent gravel, cobbles, and stones; slightly acid; abrupt, wavy boundary. 5 to 15 inches thick.

IIC2-24 to 60 inches, very gravelly coarse sand; 55 percent gravel; slightly acid.

Reaction is slightly acid or neutral. The content of coarse fragments ranges from 5 to 30 percent in the A and B horizons and from 25 to 75 percent in the IIC1 and IIC2 horizons. In places the soil has a 3-inch Al horizon of darkgray or dark grayish-brown silt loam. The A2 horizon is silt loam or loam. The B horizon is silt loam or loam and in places is gravelly. The C1 horizon ranges from coarse sandy loam to coarse sand and in places is gravelly or cobbly.

GdB-Goddard silt loam, 0 to 5 percent slopes. This nearly level to gently sloping soil is on terraces. It has the profile described as representative of the series. Included in mapping are areas where the surface layer is gravelly silt loam and a few areas where depth to gravel is more than 40 inches. Runoff is very slow or slow, and the erosion hazard is slight. This soil is used for woodland, wildlife, and limited grazing. Capability unit IVs-2 nonirrigated; woodland subclass 5o.

GdD-Goddard silt loam, 5 to 25 percent slopes. This gently sloping to moderately steep soil is on terraces. Included in mapping are a few areas of Karamin and Torboy soils. Runoff is slow or medium, and the erosion hazard is slight or moderate. This soil is used for woodland, wildlife, and limited grazing. Capability unit VIe-2 nonirrigated; woodland subclass 3o.

GdF-Goddard silt loam, 25 to 65 percent slopes. This steep to very steep soil is at terrace. edges. Included in mapping are small areas of Torboy soils. Runoff is rapid or very rapid, and the erosion hazard is severe or very severe. This soil is used for woodland, wildlife, and limited grazing. Capability subclass VIIe nonirrigated; woodland subclass 4r.

GeE-Goddard stony silt loam, 0 to 45 percent slopes. This nearly level to steep soil is on the sides of long, narrow terraces. It has a profile similar to the one described as representative of the series, but stones cover 3 to 10 percent of the surface area. Included in mapping are soils on escarpments where the surface layer is very gravelly sand. Runoff is slow to rapid, and the erosion hazard is slight to severe. This soil is used as woodland, wildlife, and limited grazing. Capability unit VIe-2 nonirrigated ; woodland subclass 5r.

Goosmus Series

The Goosmus series consists of well-drained, nearly level to very steep soils underlain by gravelly coarse sand below a depth of 20 to 40 inches. These soils formed in volcanic ash overlying glacial outwash. They are on terraces and terrace edges at elevations of 1,800 to 3,500 feet. The vegetation is mainly ponderosa pine, some Douglas-fir, and an understory of bunchgrass. The annual precipitation is 14 to 17 inches. The mean annual air temperature is about 43° F. The frost-free period is 90 to 130 days. Goosmus soils are associated with Donavan, Goddard, and Mires soils.

In a representative profile, the uppermost 14 inches is loam that is dark grayish brown in the upper part and brown in the lower part. Next, in sequence downward, is 9 inches of pale-brown gravelly sandy loam and 7 inches of light brownish-gray gravelly loamy sand. The underlying material to a depth of 60 inches or more is multicolored gravelly coarse sand.

Permeability is moderate. Available water capacity is low or moderate. Roots penetrate to a depth of 60 inches or more.

Goosmus soils are used for woodland, wildlife, grazing, and irrigated hay and pasture.

Representative profile of Goosmus loam, 0 to 3 per-

cent slopes, in woodland 800 feet east and 10 feet north of the southwest corner of sec. 6, T. 39 N., R. 34 E.

A1-0 to 7 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak, fine, granular structure; soft, very friable, nonsticky and nonplastic; many fine and very fine roots; 10 percent gravel; neutral; clear, smooth boundary. 4 to 9 inches thick.

B2-7 to 14 inches, brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; weak, fine, subangular blocky structure; soft, very friable, nonsticky and nonplastic; many fine and medium roots; 10 percent gravel; neutral; abrupt, smooth boundary. 5 to 7 inches thick.

IIC1-14 to 23 inches, pale-brown (10YR 6/3) gravelly sandy loam, brown (10YR 4/3) moist; massive; slightly hard, friable, nonsticky and nonplastic; many fine and medium roots; common fine and very fine pores; 20 percent gravel; neutral; abrupt, wavy boundary. 5 to 9 inches thick.

IIC2-23 to 30 inches, light brownish-gray (2.5Y 6/2) gravelly loamy sand, dark grayish brown (2.5Y 4/2) moist; single grained; soft, friable, nonsticky and nonplastic; few fine and medium roots; few fine and very fine pores; 40 percent gravel; neutral; abrupt, wavy boundary. 7 to 10 inches thick.

IIC3-30 to 60 inches, multicolored gravelly coarse sand; single grained; loose; few roots; 50 percent gravel; undersides of some pebbles are coated with calcium carbonate.

The B2 and C1 horizons are more than 60 percent pyroclastic material. The content of coarse fragments ranges from 5 to 25 percent in the A and B horizons and from 30 to 60 percent in the IIC1 and IIC2 horizons. The A horizon is sandy loam or loam. It is slightly acid or neutral. The B horizon is loam or sandy loam. The C1 and C2 horizons range from gravelly sandy loam to gravelly loamy sand and are neutral or mildly alkaline. The C3 horizon is gravelly coarse sand to very gravelly coarse sand. It is mildly alkaline or moderately alkaline. In places lime accumulates on the undersides of pebbles.

GlE-Goosmus very stony sandy loam, 0 to 45 percent slopes. This is a nearly level to steep soil on terraces. It has a profile similar to the one described as representative of the series, but scattered stones ranging from 10 to 20 inches in diameter are on the surface. Runoff is slow to rapid, and the erosion hazard is slight to severe. This soil is used for grazing, wildlife, and woodland. Capability unit VIs-1 nonirrigated; woodland subclass 4x.

GmF-Goosmus fine sandy loam, 35 to 65 percent slopes. This is a steep to very steep soil at terrace edges and on mountainsides. It has a profile similar to the one described as representative of the series, but is fine sandy loam to a depth of 14 inches. Runoff is rapid or very rapid, and the erosion hazard is severe or very severe. This soil is used for grazing, wildlife, and woodland. Capability subclass VIe nonirrigated; woodland subclass 4r.

GnA-Goosmus loam, 0 to 3 percent slopes. This is a nearly level soil on terraces. It has the profile described as representative of the series. Included in mapping are small areas where the slope is more than 3 percent and a few areas where the soil is gravelly sandy loam. Runoff is very slow, and the erosion hazard is slight. This soil is used for irrigated alfalfa and grass and for grazing, woodland, and wildlife. Capability unit IVs-2 nonirrigated, IIIs-1 irrigated; woodland subclass 4o.

Growden Series

The Grow den series consists of well-drained, moderately steep to very steep soils formed in a mixture of volcanic ash, loess, and colluvium derived from siliceous rocks. These soils are on southern exposures at elevations of 5,500 to 6,500 feet. The vegetation is mostly Douglas-fir, ponderosa pine, and grasses. The annual precipitation is about 25 inches. The mean annual air temperature is about 38° F. The frost-free period is 80 to 100 days. Growden soils are associated with Leonardo, Pepoon, Scar, and Togo soils.

The uppermost 6 inches in a representative profile is dark grayish-brown fine sandy loam. It is underlain by brown fine sandy loam and very stony fine sandy loam to a depth of 24 inches. Below this to a depth of 60 inches or more is brown extremely stony and very stony sandy loam that contains a few cobbles in the upper part and numerous angular cobbles in the lower part.

Permeability is moderately rapid. Available water capacity is moderate or moderately high. Roots penetrate to a depth of 60 inches or more.

Growden soils are used for woodland, grazing, and wildlife.

Representative profile of Growden fine sandy loam, 15 to 35 percent slopes, in a mountain park, NW1/4 SW1/4 sec. 18, T. 35 N., R. 35 E., Colville National Forest on Barnaby Buttes:

A11-0 to 6 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate, medium and coarse, granular structure; nonsticky and nonplastic, friable, soft; many fine roots; turfy; 10 percent fine gravel and pebbles; strongly acid; clear, wavy boundary. 5 to 8 inches thick.

A12-6 to 12 inches, brown (10YR 4/3) fine sandy loam, dark brown (10YR 3/3) moist; weak, fine, granular structure; nonsticky and nonplastic, friable, soft ; many fine roots ; 10 percent fine gravel and pebbles; medium acid; clear, wavy boundary. 6 to 8 inches thick.

A13-12 to 24 inches, brown (10YR 4/3) very stony fine sandy loam, dark brown (10YR 3/3) moist; single grained; nonsticky and nonplastic, friable, loose; many fine roots; 10 percent gravel and pebbles; 20 percent angular stones; medium acid; clear, wavy boundary. 11 to 13 inches thick.

AC-24 to 36 inches, brown (10YR 5/3) extremely stony sandy loam, dark brown (10YR 3/3) moist; single grained; nonsticky and nonplastic, friable, loose; few fine roots; 10 percent fine gravel and pebbles; 40 percent angular stones; medium acid; clear, wavy boundary, 10 to 18 inches thick.

C-36 to 60 inches, brown (10YR 5/3) very stony sandy loam, dark yellowish brown (10YR 3/4) moist; single grained; nonplastic, friable, loose; 20 percent angular stones; medium acid.

Reaction is medium acid to strongly acid. The content of coarse fragments between depths of 10 and 40 inches ranges from 35 to 60 percent. The A1 horizon is less than 60 percent pyroclastic material, but has a bulk density below 0.95. The A1 horizon is fine sandy loam to sandy loam and in places is gravelly or cobbly. The C horizon is sandy loam and is gravelly, cobbly, very gravelly, or very cobbly. It is single grained.

GoE-Growden fine sandy loam, 15 to 35 percent slopes. This moderately steep to steep soil is on south-facing mountainsides. It has the profile described as representative of the series. Runoff is medium or rapid, and the erosion hazard is moderate or severe. This soil is used for wildlife, grazing, and woodland. Capability subclass IVe nonirrigated; woodland subclass 5o.

GoF-Growden fine sandy loam, 35 to 65 percent slopes. This steep to very steep soil is on mountainsides. Runoff is rapid or very rapid, and the erosion hazard is severe or very severe. This soil is used for wildlife, woodland, and limited grazing. Capability subclass VIe nonirrigated; woodland subclass 5r.

GrE-Growden-Rock land complex, 15 to 50 percent slopes. This moderately steep to very steep mapping unit is 40 to 70 percent Growden soil and 30 to 60 percent Rock land. The Rock land is 50 to 90 percent rock outcrop and 10 to 50 percent very shallow soils. Runoff is medium to very rapid, and the erosion hazard is moderate to very severe. This mapping unit is used for grazing, wildlife, and woodland. Capability subclass VIIs nonirrigated; woodland subclass 5r for Growden soils, 5x for Rock land.

GsF-Growden association, steep. This mapping unit is about 55 percent Growden fine sandy loam and 45 percent Pepoon, Oxerine, Leonardo, and Edds soils. In most places slopes are 15 to 65 percent. Runoff is medium to very rapid, and the erosion hazard is moderate to very severe. These soils are used for woodland, wildlife, and limited grazing. Capability subclass VIIe nonirrigated; woodland subclass 5r.

Hodgson Series

The Hodgson series consists of moderately well drained, nearly level to steep soils formed in calcareous glacial lake sediments, including volcanic ash. These soils are on terraces at elevations of 1,300 to 1,900 feet. The vegetation is mostly Douglas-fir, ponderosa pine, larch, and grasses. The annual precipitation is 18 to 21 inches. The mean annual air temperature is 46° F. The frost-free period is 110 to 130 days. Hodgson soils are associated with Bisbee, Cedonia, and Scala soils.

In a representative profile, a thin layer of organic litter is at the surface. Below this, in sequence downward, is 7 inches of grayish-brown and light brownish-gray silt loam, 10 inches of light-gray silty clay loam, and 10 inches of clay loam. The underlying material to a depth of 60 inches or more is massive and laminated, very strongly calcareous, light-gray and light brownish-gray silt loam and silty clay loam.

Permeability is moderately slow. Available water capacity is high. Roots penetrate to a depth of 60 inches or more.

Hodgson soils are used for irrigated and dryfarmed grain and hay and for grazing, woodland, and wildlife.

Representative profile of Hodgson silt loam, 25 to 45 percent slopes, in a forest 800 feet east and 1,188 feet north of the southwest corner of sec. 26, T. 39 N., R. 36 E.

O1-1 inch to 0, undecomposed needles and twigs; slightly acid; abrupt, smooth boundary.

A1-0 to 2 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak, medium, platy structure; slightly hard, friable, slightly sticky and slightly plastic; many roots; common very fine pores; neutral; clear, smooth boundary. 2 to 5 inches thick.

A2-2 to 7 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak, medium, platy structure; slightly hard, friable, slightly sticky and plastic; many roots; common very fine pores; neutral; abrupt, smooth boundary. 4 to 6 inches thick.

B21t-7 to 17 inches, light-gray (2.5Y 7/2) heavy silty clay loam, brownish gray (2.5Y 5/2) moist; weak, fine, prismatic to moderate, medium, subangular blocky structure; hard, firm, sticky and plastic; many roots; common very fine pores; moderately thick clay flows in pores and on ped surfaces; neutral; abrupt, wavy boundary. 8 to 15 inches thick.

IIB22t-17 to 27 inches, light-gray (2.5Y 7/2) heavy clay loam, brownish gray (2.5Y 5/2) moist; moderate, medium, prismatic structure; slightly hard, firm, slightly sticky and slightly plastic; common roots; common very fine pores; 2 to 5 percent gravel; few, fine, faint, dark yellowish-brown (10YR 3/4) bands; calcium carbonate accumulates around roots; moderately alkaline; abrupt, smooth boundary. 2 to 11 inches thick.

IIIC1ca-27 to 34 inches, light-gray (10YR 7/2) heavy silt loam, grayish brown (10YR 5/2) moist; massive; hard, friable, slightly sticky and plastic; common roots; violently effervescent; strongly alkaline; clear, wavy boundary. 6 to 10 inches thick.

IIIC2ca-34 to 46 inches, light-gray (2.5Y 7/2) silty clay loam, brownish gray (2.5Y 5/2) moist; laminated; very hard, firm, sticky and plastic; few roots; violently effervescent; strongly alkaline; clear, smooth boundary. 10 to 20 inches thick.

IIIC3ca-46 to 60 inches, light brownish-gray (2.5Y 6/2) silty clay loam, brownish gray (2.5Y 5/2) moist; laminated; hard, firm, sticky and plastic; few roots; violently effervescent; strongly alkaline.

The 10- to 40-inch section is less than 10 percent coarse fragments. The B2t horizon is 35 to 40 percent clay. It is heavy silty clay loam or clay loam. The Cca horizon is heavy silt loam or silty *clay* loam. Reaction ranges from neutral to strongly alkaline.

HdC-Hodgson silt loam, 0 to 15 percent slopes. This is a nearly level to strongly sloping soil on terraces. About 5 percent of the total acreage of this mapping unit is included areas where the slope is greater than 15 percent. Runoff is very slow to medium, and the erosion hazard is moderate. This soil is used for dryfarmed hay and for grazing, woodland, and wildlife. Capability unit IIIe-2 nonirrigated, IIIe-2 irrigated ; woodland subclass 3o.

HdE-Hodgson silt loam, 25 to 45 percent slopes. This is a steep soil on sides of terraces. It has the profile described as representative of the series. About 10 percent of the total acreage of this mapping unit is included areas where the slope is less than 25 percent, and about 6 percent is included areas of Bisbee loamy fine sand. Runoff is rapid, and the erosion hazard is severe. This soil is used for woodland, wildlife, and grazing. Capability unit VIe-3 nonirrigated ; woodland subclass 3r.

Hodgson Variant

The Hodgson variant consists of moderately well drained, nearly level to moderately sloping soils formed in glacial lake sediments. These soils are on terraces and terrace edges at elevations of 1,300 to 1,500 feet. The vegetation is mainly an open stand of Douglas-fir and ponderosa pine and a grass understory. The annual precipitation is 18 to 21 inches. The mean annual air temperature is about 46° F. The mean annual soil temperature at a depth of 20 inches is about 48°. The frost-free period is 110 to 130 days. The Hodgson variant is associated with Cedonia and Scala soils and other Hodgson soils.

In a representative profile, the uppermost 22 inches is silt loam. The upper 9 inches is grayish brown, and

the lower 13 inches is light brownish gray. Between depths of 22 and 60 inches is silty clay loam that is light brownish gray in the upper part and light gray in the lower part.

Permeability is moderate to a depth of 22 inches and moderately slow below. Available water capacity is high. Roots penetrate to a depth of 60 inches or more.

The Hodgson variant is used for irrigated hay, pasture, and small grain. Many areas are wooded, and some provide homesites.

Representative profile of Hodgson silt loam, neutral subsoil variant, 0 to 3 percent slopes, in nonirrigated hayland 924 feet east and 2,240 feet south of the northwest corner of sec. 21, T. 37 N., R. 37 E.

Ap-0 to 9 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak, fine and medium, subangular blocky structure; slightly hard, friable, slightly sticky and plastic; many very fine roots ; common very fine pores ; medium acid; abrupt, smooth boundary. 6to9inches thick.

A2-9 to 14 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; moderate, thick, platy structure; slightly hard, friable, slightly sticky and plastic; few very fine roots; common very fine pores; neutral; clear, smooth boundary. 5 to 7 inches thick.

B21t-14 to 22 inches, light brownish-gray (2.5Y 6/2) heavy silt loam, dark grayish brown (2.5Y 4/2) moist; moderate, thick, platy structure; slightly bard, friable, sticky and plastic; few very fine roots; common very fine pores; thin, patchy clay films on surface of plates; neutral; clear, wavy boundary. 8 to 12 inches thick.

B22t-22 to 30 inches, light brownish-gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; moderate, medium, prismatic structure; hard, firm, sticky and plastic; few very fine roots; many very fine pores; few, fine, faint stains, dark yellowish brown (10YR 3/4) moist; moderately thick, continuous clay films on peds and in pores; neutral; gradual, wavy boundary. 8 to 15 inches thick.

B23t-30 to 39 inches, light-gray (2.5Y 7/2) silty clay loam, grayish brown (2.5Y 5/2) moist; moderate, medium, platy structure; slightly hard, firm, sticky and plastic; few very fine roots; common very fine pores; moderately thick, continuous clay films on peds and in pores; neutral; clear, wavy boundary. 7 to 12 inches thick.

C1-39 to 48 inches, light-gray (2.5Y 7/2) light silty clay loam, grayish brown (2.5Y 5/2) moist; laminated; slightly hard, firm, sticky and plastic; few very fine roots; common very fine pores; fine faint bands, dark yellowish brown (10YR 3/4) moist; moderately thick, discontinuous clay films on plates; neutral; abrupt, smooth boundary. 8 to 12 inches thick.

C2-48 to 60 inches, light-gray (2.5Y 7/2) light silty clay loam, grayish brown (2.5Y 5/2) moist; massive; hard, firm, sticky and slightly plastic; few very fine roots; common very fine pores; neutral.

The 10- to 40-inch section is more than 35 but less than 60 percent clay. Reaction is medium acid to neutral. The B horizon is 10YR and 2.5Y hue. The C horizon has hue of 1OYR or 2.5Y and value of 6 to 8 when dry and 4 to 6 when moist. It ranges from silt loam to silty clay loam.

HgA-Hodgson silt loam, neutral subsoil variant, 0 to 3 percent slopes. This is a nearly level soil on terraces. It has the profile described as representative of the variant. Runoff is very slow, and the erosion hazard is slight. This soil is used for irrigated and nonirrigated hay and small grain. It is also used for grazing, woodland, and wildlife. Capability unit IIIe-2 nonirrigated; IIIe-2 irrigated; woodland subclass 3o.

HgC-Hodgson silt loam, neutral subsoil variant, 3 to 15 percent slopes. This is a gently sloping to strongly sloping soil on terraces. Runoff is slow or medium, and the erosion hazard is slight or moderate. This soil is used for irrigated and nonirrigated small grain and hay. It is also used for grazing, woodland, and wildlife. Capability unit IIIe-2 nonirrigated, IIIe-2 irrigated; woodland subclass 3o.

Hum Series

The Hum series consists of well-drained, strongly sloping to steep soils formed in volcanic ash underlain by glacial till. These soils are on uplands at elevations of 1,900 to 4,300 feet. The vegetation is mainly bunchgrass and ponderosa pine. The annual precipitation is 14 to 18 inches. The mean annual air temperature is about 43° F. The mean annual soil temperature at a depth of 20 inches is less than 47°. The frost-free period is 95 to 130 days. Hum soils are associated with Koepke, Molson, and Republic soils.

The uppermost 11 inches in a representative profile is dark grayish-brown loam. It is underlain by 6 inches of light yellowish-brown loam. Between depths of 17 and 35 inches is pale-brown clay loam. This layer is underlain by light yellowish-brown gravelly clay loam and light-gray gravelly loam to a depth of 60 inches or more.

Permeability is moderately slow. Available water capacity is high. Roots penetrate to a depth of 60 inches or more.

Hum soils are used for small grain, hay, grazing, and wildlife.

Representative profile of Hum loam, 15 to 25 percent slopes, in abandoned cropland 1,650 feet west and 1,056 feet north of the southeast corner of sec. 10, T. 39 N., R. 34 E.

Ap-0 to 7 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak, fine and very fine, granular structure; soft, very friable, slightly plastic and slightly sticky; many roots; 5 percent gravel; neutral; clear, smooth boundary. 6 to 7 inches thick.

A1-7 to 11 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak, fine, granular structure; soft, very friable, slightly .plastic and slightly sticky; many roots; 5 percent gravel; neutral; clear, wavy boundary. 3 to 11 inches thick.

B21-11 to 17 inches, light yellowish-brown (10YR 6/4) loam, dark yellowish brown (10YR 3/4) moist; moderate, fine and medium, subangular blocky structure; slightly hard, friable, slightly plastic and slightly sticky; many roots; common fine and very fine pores ; 5 percent gravel ; neutral ; abrupt, wavy boundary. 0 to 12 inches thick.

IIB22t-17 to 35 inches, pale-brown (10YR 6/3) clay loam, brown (10YR 4/3) moist; massive; slightly hard, friable, plastic and slightly sticky; very few *very* fine roots; common very fine pores; thin, patchy, dark-brown (7.5YR 4/2) clay films in small pores and some thick to medium clay films in medium and large pores and cavities; 15 percent gravel; neutral; gradual, wavy boundary. 13 to 22 inches thick.

IIB3t-35 to 46 inches, light yellowish-brown (2.5Y 6/4) gravelly clay loam, olive brown (2.5Y 4/4) moist; massive; slightly hard, friable, sticky and plastic; very few very fine roots; few very fine pores; thin, patchy, dark-brown (7.5YR 4/2) clay films in

small pores and thick to medium clay films in medium and large pores and cavities; 20 percent gravel; neutral; clear, wavy boundary. 6 to 14 inches thick.

IICca-46 to 60 inches, light-gray (2.5Y 7/2) gravelly loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; very few very fine roots; few very fine pores; calcium carbonate coating pores; 20 percent gravel ; moderately alkaline and calcareous.

The content of coarse fragments in the 10- to 40-inch section ranges from 5 to 35 percent. The A horizon is loam or silt loam. The B21 horizon, where it occurs, is silt loam or loam. The IIBt horizon has hue of 10YR or 2.5Y and value of 5 or 6 when dry and 3 or 4 when moist. It is gravelly clay loam, clay loam, heavy loam, or heavy gravelly loam. Clay films range from thin and discontinuous to thick and nearly continuous in pores, root channels, and voids. The Cca horizon is gravelly loam or gravelly clay loam, is mildly alkaline or moderately alkaline, and is calcareous in most places.

HmC -Hum loam, 8 to 15 percent slopes. This strongly sloping soil is on lower hillsides and rounded hilltops. Runoff is medium, and the erosion hazard is moderate. This soil is used for alfalfa, grasses, and grazing. Capability unit IIIe-1 nonirrigated ; Loamy range site.

HmD-Hum loam, 15 to 25 percent slopes. This moderately steep soil is on hilly uplands. It has the profile described as representative of the series. Included in mapping are areas where andesite bedrock is at a depth of 2 to 3 feet and small areas of Hum silt loam, 8 to 15 percent slopes. Also included are areas of moderately steep Molson soils, which make up about 8 percent of this unit. Runoff is medium, and the erosion hazard is moderate. This soil is used for grasses and alfalfa. Capability unit IVe-1 nonirrigated; Loamy range site.

HnE-Hum stony loam, 25 to 45 percent slopes. This steep soil is on hillsides. It has a profile similar to the one described as representative of the series, but it has a stony surface layer and lime accumulation at a depth of 30 to 40 inches. Included in mapping are small areas of Molson and Hum soils and small areas of rock outcrop. Runoff is rapid, and the erosion hazard is severe. This soil is used for grazing and wildlife. Capability unit VIe-1 nonirrigated; Loamy range site.

Hunters Series

The Hunters series consists of well-drained, nearly level to steep soils formed in volcanic ash underlain by calcareous glacial lake sediments. These soils occupy terraces at elevations of 1,800 to 3,000 feet. The vegetation is mainly bunch grasses and scattered ponderosa pine. The annual precipitation is 14 to 18 inches. The mean annual air temperature is about 44° F. The frost-free period is 95 to 130 days. Hunters soils are associated with Chesaw, Mires, Molson, and Republic soils.

In a representative profile, the uppermost 12 inches is dark grayish-brown silt loam. The next 9 inches is brown silt loam. Below this to a depth of 60 inches or more is pale-brown, light-gray, and light brownishgray, strongly calcareous, partly weathered sedimentary material that ranges from very fine sandy loam to silty clay.

Permeability is moderately slow. Available water capacity is high. Roots penetrate to a depth of 33 inches or more.

Hunters soils are used mainly for grazing and wildlife. Some areas are used for grain and hay.

Representative profile of Hunters silt loam, 0 to 5 percent slopes, in a cultivated area 3,036 feet west and 2,640 feet north of the southeast corner of sec. 12, T. 39 N., R. 33 E.

Ap-0 to 6 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak, medium, platy structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; slightly acid; clear, smooth boundary. 6 to 8 inches thick.

A12-6 to 12 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak, medium, prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; slightly acid; clear, wavy boundary. 4 to 12 inches thick.

B21-12 to 21 inches, brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; moderate, medium, prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; few very fine pores; neutral; abrupt, smooth boundary. 4 to 10 inches thick.

IIB22ca-21 to 33 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; moderate, medium, prismatic structure; hard, firm, sticky and plastic; few very fine roots; few very fine and fine pores; soft powdery lime in pores; moderately alkaline; clear, wavy boundary. 8 to 15 inches thick.

IIC1ca-33 to 40 inches, light-gray (2.5Y 7/2) silt loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, friable, sticky and plastic; few very fine pores; soft powdery lime in pores; strongly effervescent; moderately alkaline; abrupt, wavy boundary. 5 to 12 inches thick.

IIIC2-40 to 48 inches, light brownish-gray (2.5Y 6/2) very fine sandy loam, dark grayish brown (2.5Y 4/2) moist; massive; soft, very friable, slightly sticky and slightly plastic; strongly effervescent; moderately alkaline; abrupt, smooth boundary. 1 inch to 8 inches thick.

IVC4-48 to 60 inches, light-gray (2.5Y 7/2) silty clay, grayish brown (2.5Y 5/2) moist; moderate, thin, platy structure; hard, firm, sticky and plastic; strongly effervescent; moderately alkaline.

The depth to lake sediments ranges from 14 to 28 inches. The horizons formed in glacial lake sediments are 18 to 30 percent clay. The depth to soft powdery lime is less than 40 inches and in places is no more than 18 inches. The Al horizon is silt loam or very fine sandy loam.

HuB-Hunters silt loam, 0 to 5 percent slopes. This is a nearly level to gently sloping soil on terraces. It has the profile described as representative of the series. Included in mapping are areas where the slope is more than 5 percent and areas of sandy soils that contain layers of loose gravel. These included soils make up about 5 percent of the unit. Runoff is very slow or slow, and the erosion hazard is slight. This soil is used for small grain, hay, grazing, and wildlife. Capability unit IIIe-1 nonirrigated, IIIe-1 irrigated ; Loamy range site.

HuC-Hunters silt loam, 5 to 15 percent slopes. This is a gently sloping to strongly sloping soil on terraces. Included in mapping are small areas of rock outcrop and areas where bedrock is at a depth of about 24 inches. Runoff is slow or medium, and the erosion hazard is slight or moderate. The entire acreage is used for grazing and wildlife. Capability unit IIIe-1 nonirrigated, IIIe-1 irrigated ; Loamy range site.

HuE-Hunters silt loam, 15 to 45 percent slopes. This is a moderately steep to steep soil on terraces. It

has a profile similar to the one described as representative of the series, but the dark grayish-brown surface layer ranges from 5 inches on convex slopes to 20 inches thick on concave slopes. Included in mapping are areas where the dark grayish-brown surface layer has been removed by erosion and the depth to lime is only 10 to 17 inches. Runoff is medium or rapid, and the erosion hazard is moderate or severe. All the acreage is used for grazing. Capability unit VIe-1 nonirrigated; Loamy range site.

Inkler Series

The Inkler series consists of well-drained, moderately steep to very steep soils formed in volcanic ash underlain by glacial till. These soils are on uplands at elevations of 2,200 to 3,000 feet. The vegetation is Douglas-fir, ponderosa pine, western larch, and pinegrass. The annual precipitation is about 22 inches. The mean annual air temperature is about 42° F. The frost-free period is 100 to 130 days. Inkler soils are associated with Nevine, Bamber, Kiehl, and Oxerine soils.

In a representative profile, the uppermost 21 inches is gravelly silt loam that is gray in the upper part and pale brown in the lower part. Between depths of 21 and 46 inches is light brownish-gray very gravelly loam. This very gravelly loam is underlain by paleyellow very gravelly sandy clay loam to a depth of 60 inches.

Permeability is moderate. Available water capacity is low. Roots penetrate to a depth of 46 inches or more.

Inkler soils are used for woodland, grazing, and wildlife.

Representative profile of Inkler gravelly silt loam, 15 to 35 percent slopes, in a forested area just above Pierre Creek Road on logging spur, 1,300 feet south and 200 feet west of northeast corner of NE1/4NE1/4 sec. 33, T. 40 N., R. 37 E.

A1-0 to 4 inches, gray (10YR 5/1) gravelly silt loam, very dark gray (10YR 3/1) moist; weak, medium and fine, subangular blocky structure; soft, friable, slightly sticky and slightly plastic; many fine roots; 20 percent angular gravel; slightly acid; clear, wavy boundary. 3 to 6 inches thick.

B21-4 to 9 inches, pale-brown (10YR 6/3) gravelly silt loam, brown (10YR 4/3) moist; weak, medium and fine, subangular blocky structure; soft, friable, slightly sticky and slightly plastic; common fine and medium roots; 20 percent angular gravel; slightly acid; clear, wavy boundary. 4 to 8 inches thick.

B22-9 to 21 inches, pale-brown (10YR 6/3) gravelly silt loam, dark brown (10YR 3/3) moist; weak, medium and coarse, subangular blocky structure; soft, friable, slightly sticky and slightly plastic; common medium roots ; root mat at lower boundary; 25 percent angular gravel; slightly acid; clear, wavy boundary. 8 to 15 inches thick.

IIB31-21 to 31 inches, light brownish-gray (2.5Y 6/2) very gravelly loam, very dark grayish brown (2.5Y 3/2) moist; massive; hard, firm, slightly sticky and slightly plastic; few fine roots; many fine tubular pores; 55 percent gravel and stones; slightly acid; gradual, wavy boundary. 6 to 12 inches thick.

IIB32-31 to 46 inches, light brownish-gray (2.5Y 6/2) very gravelly loam, dark grayish brown (2.5Y 4/2) moist; massive; slightly hard, firm, slightly sticky and slightly plastic; few fine roots; common medium tubular pores; 60 percent gravel; sand grains bridged with clay; neutral; gradual, wavy boundary. 12 to 18 inches thick.

IIB33-46 to 60 inches, pale-yellow (5Y 7/3) very gravelly sandy clay loam, olive gray (5Y 5/3) moist; massive; hard, firm, sticky and plastic; 60 percent gravel; sand grains bridged with clay; neutral.

The upper 21 inches is more than 60 percent pyroclastic material and 15 to 35 percent coarse fragments. The solum is more than 40 inches thick. Between depths of 21 and 46 inches, the soil is less than 18 percent clay and more than 35 percent coarse fragments by weighted average. Reaction ranges from medium acid to neutral and becomes less acid with increasing depth. The Al horizon is silt loam or loam and is commonly gravelly. The B2 horizon is gravelly or very gravelly. The IIB3 horizon is loam, silt loam, or sandy clay loam and is very gravelly.

InE-Inkler gravelly silt loam, 15 to 35 percent slopes. This moderately steep to steep soil is on uplands. It has the profile described as representative of the series. Runoff is medium to rapid, and the hazard of erosion is moderate or severe. This soil is used for woodland, wildlife, and limited grazing. Capability subclass IVe nonirrigated; woodland subclass 4o.

InF-Inkler gravelly silt loam, 35 to 65 percent slopes. This steep to very steep soil is on uplands. Runoff is rapid or very rapid, and the erosion hazard is severe or very severe. This soil is used for woodland, wildlife, and limited grazing. Capability subclass VIe nonirrigated; woodland subclass 4r.

IrE-Inkler-Rock land complex, 15 to 50 percent slopes. This moderately steep to very steep mapping unit is on mountainsides. It is 40 to 70 percent Inkler gravelly silt loam and 30 to 60 percent Rock land. Rock land is 50 to 90 percent rock outcrop and 10 to 50 percent very shallow soils. Runoff is medium to very rapid, and the erosion hazard is moderate to very severe. This mapping unit is used for woodland, wildlife, and limited grazing. Capability subclass VIIs nonirrigated; woodland subclass 4r for Inkler soils, 5x for Rock land.

Karamin Series

The Karamin series consists of well-drained, nearly level to strongly sloping soils that are sandy below a depth of 12 to 15 inches. These soils formed in glacial outwash. They are on uplands at elevations of 3,000 to 4,500 feet. The vegetation is mostly Douglas-fir, lodgepole pine, and western larch. The annual precipitation is 20 to 30 inches. The mean annual air temperature is 41° to 43° F. The frost-free period is 100 to 120 days. Karamin soils are associated with Manley, Gahee, Goddard, Merkel, and Torboy soils.

Beneath a thin organic litter in a representative profile is 13 inches of fine sandy loam that is light gray in the upper 2 inches and very pale brown below. The next 5 inches is very pale brown loamy fine sand. The underlying material to a depth of 60 inches or more is light-gray fine sand.

Permeability is rapid. Available water capacity is low. Roots penetrate to a depth of 60 inches or more.

These soils are used for woodland, wildlife, and limited grazing.

Representative profile of Karamin fine sandy loam, 0 to 15 percent slopes, in a forested area along Swan Lake forest road, Republic Ranger District, SE1/4 sec. 20, T. 36 N., R. 32 E. Colville National Forest:

O1-1/2 inch to 0, twigs, needles, and leaves.

A2-0 to 2 inches, light-gray (10YR 7/1) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak, very

fine, granular structure; soft, very friable, nonsticky and nonplastic; many fine roots; considerable charcoal; strongly acid; abrupt, smooth boundary. 1 inch to 3 inches thick.

B2-2 to 13 inches, very pale brown (10YR 7/3) fine sandy loam, dark yellowish brown (10YR 4/4) moist; very weak, medium, subangular blocky structure; soft, very friable, nonsticky and nonplastic; many fine roots; slightly acid; clear, wavy boundary. 10 to 12 inches thick.

B3-13 to 18 inches, very pale brown (10YR 7/3) loamy fine sand, dark yellowish brown (10YR 4/4) moist; very weak, medium and fine, subangular blocky structure; soft, very friable, nonsticky and nonplastic; many fine roots; medium acid; clear, wavy boundary. 5 to 8 inches thick.

C-18 to 60 inches, light-gray (10YR 7/1) fine sand, grayish brown (10YR 5/2) moist; single grained ; soft, very friable, nonsticky and nonplastic; few fine roots; medium acid.

Depth to loamy fine sand ranges from 12 to 15 inches. The content of coarse fragments between depths of 10 and 40 inches is less than 5 percent. The A2 horizon ranges from loam to fine sandy loam and is medium acid or strongly acid. The B2 horizon ranges from fine sandy loam to loam and is strongly acid to slightly acid. The C horizon is medium acid or strongly acid.

KaC-Karamin fine sandy loam, 0 to 15 percent slopes. This is a nearly level to strongly sloping soil on terraces. It has the profile described as representative of the series. Included in mapping are a few small areas of steep soils at terrace edges. Runoff is very slow to medium, and the erosion hazard is moderate. This soil is used for woodland, wildlife, and limited grazing. Capability subclass IVe nonirrigated; woodland subclass 3o.

Kiehl Series

The Kiehl series consists of well-drained, nearly level to very steep soils formed in volcanic ash underlain by glacial outwash. These soils occupy terraces and terrace edges at elevations of 2,800 to 3,500 feet. The vegetation is mainly Douglas-fir, western larch, and lodgepole pine. The annual precipitation is about 28 inches. The mean annual air temperature is about 40° F. The frost-free period is 90 to 110 days. Kiehl soils are associated with Donavan, Nevine, and Oxerine soils.

In a representative profile, a thin layer of organic litter is at the surface. Next, in sequence downward, is 11 inches of pink gravelly silt loam, 11 inches of very pale brown cobbly fine sandy loam, and 6 inches of very pale brown loamy sand. The underlying material to a depth of 60 inches or more is very pale brown very gravelly loamy coarse sand.

Permeability is rapid. Available water capacity is low. Roots penetrate to a depth of 60 inches or more.

Kiehl soils are used for woodland, wildlife, and grazing.

Representative profile of Kiehl gravelly silt loam, 0 to 15 percent slopes, in a forested area, sec. 20, T. 40 N., R. 38 E. Northern headland of Flat Creek, in an open park stand of fir and larch just south of forest road connecting Sheep Creek and Pierre Creek:

O2-1 inch to 0, partly decomposed leaves, twigs, needles, and grass roots.

B21ir-0 to 11 inches, pink (7.5YR 7/4) gravelly silt loam, strong brown (7.5YR 5/6) moist; weak, fine, granular and weak, fine and medium, subangular blocky structure; soft, friable, nonsticky and nonplastic; many fine roots; 20 percent angular shaly gravel; slightly acid; clear, wavy boundary. 10 to 12 inches thick.

IIB22ir-11 to 22 inches, very pale brown (10YR 7/4) cobbly fine sandy loam, yellowish brown (10YR 5/8) moist; single grained; loose, friable, nonsticky and nonplastic; many fine roots, with concentration of roots at lower boundary; 40 percent cobbles, stones, boulders, and gravel; slightly acid; clear, wavy boundary. 10 to 12 inches thick.

IIIB3-22 to 28 inches, very pale brown (10YR 7/4) loamy sand, yellowish brown (10YR 5/4) moist; single grained; loose, friable, nonsticky and nonplastic; common fine roots; 70 percent stones, cobbles, boulders, and gravel; slightly acid; clear, wavy boundary. 4 to 8 inches thick.

IIIC-28 to 60 inches, very pale brown (10YR 7/3) very gravelly loamy coarse sand, brown (10YR 5/3) moist; single grained; loose; friable, nonsticky and nonplastic; few fine roots; 70 percent gravel, cobbles, stones, and boulders; slightly acid.

Reaction is slightly acid or neutral. The upper 20 to 24 inches is 20 to 40 percent coarse fragments and 60 percent or more pyroclastic material. The IIIB3 and IIIC horizons are 50 to 80 percent coarse fragments, and the material finer than fine sand is dominantly volcanic ash. The Bir horizon is loam, silt loam, or fine sandy loam and is gravelly or cobbly. The C horizon ranges from loamy sand to coarse sand and is very gravelly or very cobbly.

KeC-Kiehl gravelly silt loam, 0 to 15 percent slopes. This nearly level to strongly sloping soil is on terraces. It has the profile described as representative of the series. Runoff is slow or medium, and the erosion hazard slight or moderate. This soil is used for woodland, wildlife, and limited grazing. Capability subclass IVe nonirrigated; woodland subclass 3o.

KeF-Kiehl gravelly silt loam, 35 to 65 percent slopes. This steep to very steep soil is at terrace edges. Runoff is rapid or very rapid, and the erosion hazard is severe or very severe. This soil is used for woodland, wildlife, and limited grazing. Capability subclass VIIe nonirrigated; woodland subclass 4r.

Koepke Series

The Koepke series consists of well-drained, nearly level to steer soils formed in volcanic ash overlying glacial till. These soils are on uplands at elevations of 1,900 to 4,000 feet. The vegetation is mainly Idaho fescue, rough fescue, bluebunch wheatgrass. and scattered ponderosa pine and Douglas-fir. The annual precipitation is 14 to 18 inches. The mean annual temperature is about 43° F. The frost-free period is 90 to 125 days. Koepke soils are associated with Cobey, Donavan, Hum, Hunters, Molson, and Republic soils.

In a representative profile, a thin layer of organic litter is at the surface. Next, in sequence downward, is 18 inches of very dark gray loam, 10 inches of very dark gray sandy loam, and 21 inches of gravelly sandy loam that is dark grayish brown and pale brown in the upper part and light brownish gray in the lower part. Below this to a depth of 60 inches or more is light-gray very gravelly sandy loam.

Permeability is moderately slow. Available water capacity is moderate or moderately high. Roots penetrate to a depth of 49 inches or more.

Koepke soils are used for small grain, hay, grazing, and wildlife.

Representative profile of Koepke loam, 0 to 8 percent

slopes, in grassland 500 feet south on Catherine Creek Road from fence crossing and 40 feet south of road in the SE1/4SE1/4 sec. 2, T. 40 N., R. 32 E.

O1-1 inch to 0, partly decomposed litter; abrupt, smooth boundary.
A11-0 to 9 inches, very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; weak, very fine, granular structure; soft, very friable, nonsticky and nonplastic; common roots; 10 percent gravel; neutral; diffuse, wavy boundary. 5 to 9 inches thick.
A12-9 to 18 inches, very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; massive; soft, very friable, nonsticky and nonplastic; common roots; 2 percent gravel; neutral; abrupt, wavy boundary. 5 to 13 inches thick.
A13-18 to 28 inches, very dark gray (10YR 3/1) sandy loam, black (10YR 2/1) moist; massive; soft, very friable, nonsticky and nonplastic; common roots; neutral; clear, irregular boundary. 5 to 10 inches thick.
IIA14-28 to 34 inches, dark grayish-brown (10YR 4/2) gravelly sandy loam, very dark brown (10YR 2/2) moist; weak, medium, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common roots; 20 percent gravel; neutral; clear, wavy boundary. 5 to 8 inches thick.
IIB2-34 to 41 inches, pale-brown (10YR 6/3) gravelly sandy loam, dark brown or brown (10YR 4/3) moist; weak, medium, subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few roots; 30 percent gravel; neutral; abrupt, wavy boundary. 6 to 14 inches thick.
IIC1-41 to 49 inches, light brownish-gray (10YR 6/2) gravelly sandy loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable, nonsticky and nonplastic; few roots; 30 percent gravel; neutral; abrupt, wavy boundary. 8 to 13 inches thick.
IIC2-49 to 60 inches, light-gray (2.5Y 7/2) very gravelly sandy loam, grayish brown (2.5Y 5/2) moist; single grained; loose, friable, slightly sticky and nonplastic; strongly effervescent; strongly alkaline.

The content of coarse fragments ranges from 0 to 20 percent in the upper 28 inches and from 15 to 35 percent in the IIA, IIB, and IIC horizons. The upper 28 inches is more than 60 percent pyroclastic material. The Al horizon is 20 to 40 inches thick and 7 to 8 percent organic carbon. It ranges from silt loam to sandy loam and in places is gravelly. The IIA, IIB, and IIC horizons range from gravelly sandy loam to gravelly loam. The IIC2 horizon ranges from very gravelly sandy loam to very gravelly loam and is mildly alkaline to strongly alkaline and calcareous.

KoB-Koepke loam, 0 to 8 percent slopes. This is a nearly level to gently sloping soil on uplands. It has the profile described as representative of the series. Included in mapping are areas of steep Koepke soils, which make up about 10 percent of this unit. Runoff is slow or medium, and the erosion hazard is slight or moderate. This soil is used for small grain, hay, pasture, and grazing. Capability unit IIIe-1 nonirrigated; Loamy range site ; woodland subclass 3o.

KoC-Koepke loam, 8 to 15 percent slopes. This is a strongly sloping soil on uplands. Included in mapping are somewhat poorly drained soils, which make up about 8 percent of this unit, and Molson loam, 15 to 25 percent slopes, which makes up about 7 percent. Runoff is medium, and the erosion hazard is moderate. This soil is used for hay and pasture and for grazing. It also provides winter habitat for wildlife. Capability unit IIIe-1 nonirrigated; Loamy range site; woodland subclass 3o.

KoD-Koepke loam, 15 to 25 percent slopes. This is a moderately steep soil on uplands. Runoff is medium, and the erosion hazard is moderate. This soil is used for grazing, wildlife, and woodland. Capability unit IVe-1 nonirrigated; Loamy range site; woodland subclass 3o.

KoE-Koepke loam, 25 to 45 percent slopes. This is a steep soil on uplands. Runoff is rapid, and the erosion hazard is severe. This soil is used for grazing, wildlife, and woodland. Capability unit VIe-1 nonirrigated; Loamy range site; woodland subclass 3r.

Koerling Series

The Koerling series consists of well-drained, nearly level to very steep soils formed in glacial outwash of volcanic ash and loess. The outwash overlies stratified lake sediments. These soils occupy terraces and terrace edges at elevations of 1,500 to 2,000 feet. The vegetation is mainly ponderosa pine, Douglas-fir, and larch. The annual precipitation is 16 to 18 inches. The mean annual air temperature is about 45° F. The frost-free period is 110 to 130 days. Koerling soils are associated with Cedonia, Dart, and Hunters soils.

The uppermost 10 inches in a representative profile is grayish-brown fine sandy loam. Beneath this to a depth of 40 inches is fine sandy loam that is pale brown in the upper part and light brownish gray in the lower part. The underlying material to a depth of 60 -inches or more is light-gray silty clay loam.

Permeability is moderate. Available water capacity is high. Roots penetrate to a depth of 60 inches or more.

Koerling soils are used for grain, hay, woodland, and wildlife.

Representative profile of Koerling fine sandy loam, 0 to 15 percent slopes, in a cultivated field 240 feet west on Road 583 from the E1/4 corner of sec. 29 and 50 feet north, NE1/4SE1/4SE1/4 sec. 29, T. 36 N., R. 38 E.

Ap-0 to 10 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, fine and medium, granular structure; slightly hard, very friable, slightly sticky; many roots; neutral; abrupt, smooth boundary. 4 to 10 inches thick.
B21-10 to 22 inches, pale-brown (10YR 6/3) fine sandy loam, brown (10YR 4/3) moist; weak, fine and medium, subangular blocky structure; slightly hard, very friable, slightly sticky; many roots; common very fine pores; neutral; gradual, wavy boundary. 10 to 14 inches thick.
B22-22 to 40 inches, light brownish-gray (2.5Y 6/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; few, fine, distinct mottles, dark brown (10YR 3/3) moist; weak, fine and medium, subangular blocky structure; slightly hard, very friable, slightly sticky; common fine roots; common very fine and fine pores; mildly alkaline; clear, wavy boundary. 10 to 20 inches thick.
IICca-40 to 60 inches, light-gray (2.5Y 7/2) silty clay loam, grayish brown (2.5Y 5/2) moist; massive with laminations; very hard, firm, sticky and plastic; few fine roots; few fine and very fine pores; dark-brown organic or manganese coating on surface of plates; effervesecent in dilute hydrochloric acid; moderately alkaline.

Between depths of 10 and 40 inches, the soil is less than 18 percent clay, more than 15 percent material coarser than very fine sand, and up to 15 percent coarse fragments.

Depth to calcareous lake sediments ranges from 24 to 44

inches. The A1 or Ap horizon is fine sandy loam or sandy loam. The B horizon is sandy loam or fine sandy loam. The IIC horizon is sandy loam or silty clay loam and is mildly alkaline or moderately alkaline.

KrC-Koerling fine sandy loam, 0 to 15 percent slopes. This nearly level to strongly sloping soil is on terraces. It has the profile described as representative of the series. Runoff is slow or medium, and the erosion hazard is slight or moderate. This soil is used for hay, small grain, woodland, and wildlife. Capability subclass IIIe nonirrigated; woodland subclass 3o.

KrF-Koerling fine sandy loam, 35 to 65 percent slopes. This steep to very steep soil is at terrace edges. Runoff is rapid or very rapid, and the erosion hazard is severe *or very* severe. This soil is used as woodland and wildlife habitat. Capability subclass VIe nonirrigated; woodland subclass 3r.

Leonardo Series

The Leonardo series consists of well-drained, moderately steep to very steep soils formed in glacial till, the upper part of which is mixed with volcanic ash and loess. These soils are on uplands at elevations of 5,500 to 6,500 feet. The vegetation is mainly Douglas-fir, ponderosa pine, and grasses. The annual precipitation is 35 to 40 inches. The mean annual air temperature is about 40° F. The frost-free period is 80 to 100 days. Leonardo soils are associated with Growden, Edds, Scar, and Togo soils.

In a representative profile, the uppermost 16 inches is dark grayish-brown fine sandy loam. It is underlain by brown very stony fine sandy loam to a depth of 38 inches. Beneath this to a depth of 60 inches or more is yellowish-brown extremely stony sandy loam.

Permeability is moderately rapid. Available water capacity is low or moderate. Roots penetrate to a depth of 38 inches or more.

Leonardo soils are used for grazing and wildlife.

Representative profile of Leonardo fine sandy loam, 15 to 35 percent slopes, in a mountain park NW1/4 sec. 15, T. 38 N., R. 35 E. On Taylor Ridge, Kettle Falls Ranger District, Colville National Forest:

A11-0 to 8 inches, dark grayish-brown (10YR 4/2) fine sandy loam, black (10YR 2/1) moist; moderate, medium, granular structure; soft, friable, nonsticky and nonplastic; many fine roots of turf mat; 15 percent shay gravel; medium acid; clear, wavy boundary. 7 to 9 inches thick.

A12-8 to 16 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak, fine, granular structure; soft, friable, nonsticky and nonplastic; many fine roots; 10 percent shaly gravel; medium acid; clear, wavy boundary. 8 to 10 inches thick.

AC-16 to 38 inches, brown (10YR 4/3) very stony fine sandy loam, dark brown (10YR 3/3) moist; single grained; loose, friable, nonsticky and nonplastic; few fine roots; 10 percent fine gravel and 15 percent angular stones; medium acid; clear, wavy boundary. 10 to 24 inches thick.

IIC-38 to 60 inches, yellowish-brown (10YR 5/4) extremely stony sandy loam, brown (10YR 4/3) moist; single grained; loose, friable, nonsticky and nonplastic; 50 percent angular stones and 20 per cent fine gravel; medium acid.

The upper 16 inches is more than 60 percent pyroclastic material. The content of coarse fragments in the A11, A12, and AC horizons ranges from 5 to 35 percent and in the IIC horizon exceeds 50 percent. Reaction is medium acid or slightly acid. The Al horizon is sandy loam, fine sandy loam, or loam and in places is gravelly. The AC horizon is loam or fine sandy loam and is gravelly or very stony. The C horizon is sandy loam or fine sandy loam and in places is very gravelly, very stony, or extremely stony.

LeE-Leonardo fine sandy loam, 15 to 35 percent slopes. This is a moderately steep to steep soil on mountainsides. It has the profile described as representative of the series. Included in mapping are a few small areas of Togo, Edds, and Growden soils. Runoff is medium or rapid, and the erosion hazard is moderate or severe. This soil is used for wildlife, woodland, and grazing. Capability subclass IVe nonirrigated; woodland subclass 3o.

LeF-Leonardo fine sandy loam, 35 to 65 percent slopes. This is a steep to very steep soil on mountainsides. Included in mapping are small areas of Togo, Edds, and Growden soils. Runoff is rapid or very rapid, and the erosion hazard is severe or very severe. This soil is used for wildlife, woodland, and limited grazing. Capability subclass VIe nonirrigated; woodland subclass 3r.

LrE-Leonardo-Rock Land complex, 15 to 50 percent slopes. This is a moderately steep to very steep mapping unit on mountainsides. It is 40 to 70 percent Leonardo fine sandy loam and 30 to 60 percent Rock land. Rock land is 50 to 90 percent rock outcrop and 10 to 50 percent very shallow soils. Runoff is medium to very rapid, and the erosion hazard is moderate to very severe. This soil is used for wildlife, woodland, and limited grazing. Capability subclass VIIs nonirrigated; woodland subclass 3r for Leonardo soil, 5x for Rock land.

Malo Series

The Malo series consists of well-drained, nearly level soils formed in alluvium derived from acid igneous rock and volcanic ash. These soils are on flood plains at elevations of 1,500 to 1,700 feet. The vegetation is mainly ponderosa pine, Douglas-fir, and aspen and an understory of grasses and snowberry. The annual precipitation is 14 to 19 inches. The mean annual air temperature is about 46° F. The frost-free period is 100 to 130 days. Malo soils are associated with Mixed alluvial land and Ret soils.

In a representative profile, the surface layer is silt loam to a depth of 28 inches. The upper 5 inches is dark grayish brown, the next 11 inches is grayish brown, and the lower 12 inches is brown. This layer is underlain by 23 inches of light brownish-gray fine sandy loam and sandy loam. Below this to a depth of 60 inches or more is light-gray loamy sand. There are lime coatings in some pores and root channels.

Permeability is moderate. Available water capacity is high. Roots penetrate to a depth of 60 inches or more.

Malo soils are used for irrigated hay, pasture, and small grain.

Representative profile of Malo silt loam in irrigated hayland 400 feet east and 300 feet north of the southwest corner of NW1/4SW1/4 sec. 9, T. 40 N., R. 34 E.

Ap-0 to 5 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate, medium, granular structure; soft, very fri-

able, nonsticky and slightly plastic; common roots; neutral; abrupt, smooth boundary. 4 to 7 inches thick.

A1-5 to 16 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak, medium, subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common roots; common fine pores; neutral; clear, smooth boundary. 3 to 12 inches thick.

AC-16 to 28 inches, brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; weak, medium, prismatic structure; soft, friable, nonsticky and slightly plastic; common roots; common fine pores; neutral; gradual, smooth boundary. 4 to 12 inches thick.

C1-28 to 38 inches, light brownish-gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; soft, very friable, nonsticky and nonplastic; common roots; few fine pores; neutral; gradual, smooth boundary. 6 to 16 inches thick.

C2-38 to 51 inches, light brownish-gray (2.5Y 6/2) sandy loam, dark grayish brown (2.5Y 4/2) moist; massive; soft, very friable, nonsticky and nonplastic; few roots; few fine pores; common lime coatings in pores and root channels; moderately alkaline; clear, smooth boundary. 8 to 16 inches thick.

C3-51 to 60 inches, light-gray (2.5Y 7/2) loamy sand, grayish brown (2.5Y 5/2) moist; massive; soft, friable, nonsticky and nonplastic; few roots; mildly alkaline.

Between depths of 10 to 14 inches, the soil is less than 18 percent clay and more than 15 percent material coarser than very fine sand. The A1 or Ap horizon is silt loam or very fine sandy loam. The AC and C horizons are stratified fine sandy loam, sandy loam, loamy sand, silt loam, loam, or very fine sandy loam.

Ma-Malo silt loam. This nearly level soil is on bottom land. It has the profile described as representative of the series. As much as 20 percent of each mapped area is black fine sandy loam underlain by gravelly sand. Some low-lying areas are subirrigated in spring and early in summer. Runoff is very slow, and the erosion hazard is slight. This soil is used for hay, pasture, small grain, and row crops. Capability unit IIIe-1 nonirrigated, IIIe-3 irrigated.

Malo Variant

This variant of the Malo series consists of somewhat excessively drained, nearly level soils formed in recent alluvium. These soils are on bottom land at elevations of 1,500 to 1,700 feet. The vegetation is mainly ponderosa pine, Douglas-fir, grasses, and aspen. The annual precipitation is 14 to 19 inches. The mean annual air temperature is about 46° F. The frost-free period is 100 to 130 days. This variant is associated with other Malo soils, Mixed alluvial land, and Ret soils.

In a representative profile, the uppermost 29 inches is sandy loam. The upper 7 inches is dark grayish brown, the next 12 inches is pale brown, and the lower 10 inches is light yellowish brown. Below this is 27 inches of light yellowish-brown or multicolored sand. The underlying material to a depth of 60 inches or more is very gravelly coarse sand.

Permeability is moderately rapid. Available water capacity is low. Roots penetrate to a depth of 40 to 60 inches.

The Malo variant is used for irrigated small grain, alfalfa, and grass. It also provides cabin sites.

Representative profile of Malo sandy loam, coarse subsoil variant, 1,920 feet north and 1,320 feet west of the southeast corner of sec. 29, T. 38 N., R. 37 E.

O1-1/4 inch to 0, undecomposed needles, grass, and twigs.

A1-0 to 7 inches, dark grayish-brown (10YR 4/2) sandy loam, very dark brown (10YR 2/2) moist; weak, thick, platy structure; soft, very friable, nonsticky and nonplastic; many very fine roots; slightly acid; clear, smooth boundary. 7 to 9 inches thick.

AC-7 to 19 inches, pale-brown (10YR 6/3) sandy loam, brown or dark brown (10YR 4/3) moist; weak, fine, prismatic structure; soft, very friable, nonsticky and nonplastic; common fine and medium roots; neutral; clear, smooth boundary. 8 to 12 inches thick.

C1-19 to 29 inches, light yellowish-brown (2.5Y 6/4) sandy loam, olive brown (2.5Y 4/4) moist; massive; soft, very friable, nonsticky and nonplastic; common fine and medium roots; neutral; gradual, wavy boundary. 5 to 10 inches thick.

C2-29 to 44 inches, light yellowish-brown (10YR 6/4) sand, olive brown (2.5Y 4/4) moist; massive; soft, loose, nonsticky and nonplastic; common roots; neutral; gradual, smooth boundary. 10 to 15 inches thick.

C3-44 to 56 inches, multicolored sand; single grained; neutral; abrupt, wavy boundary. 5 to 12 inches thick.

C4-56 to 60 inches, very gravelly coarse sand; loose; neutral.

The A1 horizon is dark grayish-brown or grayish-brown fine sandy loam or sandy loam. The AC and C horizons range from sandy loam to sand or very gravelly sand. In places, thin lenses of very fine sandy loam, loam, or silt loam are within 24 inches of the surface. Reaction ranges from slightly acid to mildly alkaline.

Mb-Malo sandy loam, coarse subsoil variant. This nearly level soil formed in recent alluvium. It has the profile described as representative of the variant. Included in mapping are soils that have a surface layer of loamy sand or soils that have very gravelly sand at a depth of about 24 inches. These included soils make up about 10 percent of this unit. Runoff is very slow, and the erosion hazard is slight. This Malo soil is subject to occasional overflow during spring runoff. It is used for irrigated small grain and alfalfa. It also provides grazing and homesites. Capability unit IVs-3 nonirrigated, IVs-1 irrigated.

Manley Series

The Manley series consists of well-drained, nearly level to very steep soils formed in volcanic ash overlying glacial till. These soils are on mountainous uplands at elevations of 3,000 to 6,000 feet. The vegetation is mainly subalpine fir and Douglas-fir and an understory of ninebark, pachistima, and pinegrass. The annual precipitation is 20 to 35 inches. The mean annual air temperature is 37° to 39° F. The frost-free period is 80 to 100 days. Manley soils are associated with Nevine, Scar, and Togo soils.

In a representative profile, a mat about 1 inch thick of decaying forest litter overlies a very thin layer of light-gray loam. Below this is about 20 inches of lightbrown and light yellowish-brown silt loam. The underlying material to a depth of 60 inches or more is light yellowish-brown gravelly sandy loam.

Permeability is moderate. Available water capacity is low to moderately high. Roots penetrate to a depth of 60 inches or more.

Manley soils are used for grazing, woodland, and wildlife.

Representative profile of Manley silt loam, 0 to 15 percent slopes, in a forested area 1,980 feet east and 160 feet south of the northwest corner of sec. 7, T. 40 N., R. 34 E.

O1-1 to 1/2 inch, undecomposed needles, bark, twigs, and grass.
O2-1/2 inch to 0, decomposed mat of organic material, black (10YR 2/1) moist; neutral.
A2-0 to 1/4 inch, light-gray (10YR 7/2) loam, grayish brown (10YR 5/2) moist; strongly acid. 1/4 inch to 1 1/2 inches thick.
B21-1/4 inch to 5 inches, light-brown (7.5YR 6/4) silt loam, dark brown (7.5YR 3/4) moist; weak, very fine, granular structure; soft, very friable, nonsticky and nonplastic; many, very fine, fine, and medium roots; 10 percent gravel; medium acid; clear, smooth boundary. 4 to 10 inches thick.
B22-5 to 10 inches, light-brown (7.5YR 6/4) silt loam, dark brown to brown (7.5YR 4/4) moist; weak, fine, granular structure; soft, very friable, nonsticky and nonplastic; common roots; 10 percent gravel; slightly acid; clear, wavy boundary. 4 to 6 inches thick.
B23-10 to 20 inches, light yellowish-brown (10YR 6/4) silt loam, dark yellowish brown (10YR 4/4) moist; weak, medium, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common roots; common fine and very fine pores; 10 percent gravel; neutral; clear, wavy boundary. 5 to 10 inches thick.
IIC1-20 to 35 inches, light yellowish-brown (10YR 6/4) gravelly sandy loam, dark yellowish brown (10YR 4/4) moist; massive; slightly plastic; common fine and very fine roots; 35 percent gravel and 10 percent cobbles and stones ; neutral ; gradual, wavy boundary. 10 to 25 inches thick.
IIC2-35 to 60 inches, light yellowish-brown (2.5Y 6/4) gravelly sandy loam, olive brown (2.5Y 4/4) moist; massive; slightly plastic; common fine and very fine roots; 35 percent gravel and 10 percent cobbles and stones; neutral.

The upper 20 inches is more than 60 percent pyroclastic material and up to 20 percent coarse fragments. Between depths of 20 and 40 inches, the soil is 30 to 50 percent coarse fragments. The A2 horizon is loam, silt loam, or very fine sandy loam. The B horizon is silt loam, loam, or fine sandy loam. The C horizon is gravelly loam or gravelly sandy loam and in places contains thin subhorizons of loamy sand.

McC-Manley silt loam, 0 to 15 percent slopes. This is a nearly level to steep soil on uplands. It has the profile described as representative of the series. Included in mapping are small areas where coarse sand over granitic bedrock is within a depth of 60 inches and a few areas where the soil is steep. Runoff is slow or medium, and the erosion hazard is slight or moderate. This soil is used for woodland, wildlife, and grazing. Capability unit IVe-2 nonirrigated ; woodland subclass 2o.

McE-Manley silt loam, 15 to 35 percent slopes. This is a moderately steep to steep soil on mountainsides. Included in mapping are a few small areas of Nevine soils and Rock land. Runoff is medium or rapid, and the erosion hazard is moderate or severe. This soil is used as woodland and wildlife habitat. Capability unit VIe-2 nonirrigated; woodland subclass 4o.

McF-Manley silt loam, 35 to 65 percent slopes. This is a steep to very steep soil on mountainsides and at terrace edges. Runoff is rapid or very rapid, and the erosion hazard is severe or very severe. This soil is used as woodland and wildlife habitat. Capability subclass VIe nonirrigated; woodland subclass 4r.

MdE-Manley-Rock land complex, 15 to 50 percent slopes. This moderately steep to very steep mapping unit is 40 to 70 percent Manley silt loam and 30 to 60 percent Rock land. Rock land is 50 to 90 percent rock outcrop and 10 to 50 percent very shallow soils. Runoff is medium to very rapid, and the erosion hazard is moderate to very severe. This mapping unit is used as woodland and wildlife habitat. Capability subclass VIIs nonirrigated; woodland subclass 4r for Manley soil, 5x for Rock land.

Marsh

Mh-Marsh is very poorly drained. Generally it occurs in depressions where the water table is at or above the surface and drainage is impractical. The plant cover is mainly rushes and cattails. Areas of Marsh are used by wildlife and for water storage. Capability unit VIIIw-1 nonirrigated.

Merkel Series

The Merkel series consists of well-drained, nearly level to very steep soils formed in volcanic ash over granitic glacial till. These soils are on mountainous uplands at elevations of 2,500 to 4,500 feet. The vegetation is mainly Douglas-fir and ponderosa pine on south-facing slopes and western larch, pinegrass, snowberry, and ninebark in other areas. The annual precipitation is 17 to 24 inches. The mean annual air temperature is about 43° F. The frost-free period is 90 to 120 days. Merkel soils are associated with Goddard, Nevine, Talls, and Torboy soils.

In a representative profile, a thin layer of decomposing pine needles, twigs, and grass is at the surface. Next, in sequence downward, is a 3/4-inch layer of light brownish-gray sandy loam, about 16 inches of sandy loam that is pale brown in the upper part and light yellowish brown in the lower part, 22 inches of pale-brown gravelly sandy loam, and 7 inches of light-gray gravelly coarse sandy loam. Below this to a depth of 60 inches or more is light-gray gravelly loamy coarse sand.

Permeability is moderate as far down as the gravelly sandy loam and moderately rapid below. Available water capacity is low. Roots extend to a depth of 60 inches or more.

Merkel soils are used for woodland, wildlife, and grazing.

Representative profile of Merkel sandy loam, 0 to 15 percent slopes, in a forested area 160 feet west of power line and 100 feet north of logging road in the southeast corner of sec. 30, T. 37 N., R. 32 E.

O1-1 inch to 0, partly decomposed needles, twigs, and grass; neutral.
A2-0 to 3/4 inch, light brownish-gray (10YR 6/2) sandy loam, dark grayish brown (10YR 5/2) moist; massive; soft; neutral; abrupt, smooth boundary. 0 to 1 inch thick.
B21-3/4 inch to 9 inches, pale-brown (10YR 6/3) sandy loam, dark brown or brown (10YR 4/3) moist; weak, medium, subangular blocky structure; soft, very friable, slightly sticky and nonplastic; many roots; 15 percent gravel and cobbles; neutral; clear, smooth boundary. 4 to 10 inches thick.
B22-9 to 17 inches, light yellowish-brown (10YR 6/4) sandy loam, dark yellowish brown (10YR 4/4) moist; weak, medium, subangular blocky struc-

ture; soft, very friable, slightly sticky and nonplastic; many roots; 15 percent gravel, cobbles, and stones; few fine pores; neutral; abrupt, wavy boundary. 6 to 14 inches thick.

IIB23-17 to 39 inches, pale-brown (10YR 6/3) gravelly sandy loam, brown or dark brown (10YR 4/3) moist; many, medium, faint mottles, dark yellowish brown (10YR 4/4) moist; massive; slightly hard, friable, nonsticky and nonplastic; common roots; common fine pores; 30 percent gravel and 23 percent cobbles and stones; slightly acid; clear, wavy boundary. 15 to 30 inches thick.

IIC1-39 to 46 inches, light-gray (10YR 7/2) gravelly coarse sandy loam, brown (10YR 5/3) moist; few, medium, faint mottles, brown (10YR 4/3) moist; massive; slightly hard, friable, nonsticky and nonplastic; common roots; few fine pores; 30 percent gravel and 25 percent cobbles and stones ; slightly acid; abrupt, wavy boundary. 5 to 10 inches thick.

IIC2-46 to 60 inches, light-gray (2.5Y 7/2) gravelly loamy coarse sand, grayish brown (2.5Y 5/2) moist; massive; slightly hard, compact and friable, nonsticky and nonplastic; few roots; 35 percent gravel and 25 percent cobbles and stones; neutral.

The A2, B21, and B22 horizons are 30 to 60 percent pyroclastic material and 0 to 15 percent coarse fragments. The A2 horizon is sandy loam or light loam, is less than 4 inches thick, and is discontinuous. The B horizon is sandy loam or light loam. The C horizon ranges from sandy loam to sand and in places is gravelly or very gravelly.

MkC-Merkel sandy loam, 0 to 15 percent slopes. This nearly level to strongly sloping soil is on the sides of basins. It has the profile described as representative of the series. Included in mapping are small areas where the slope is 15 to 25 percent, some areas of cultivated soil that has a dark grayish-brown surface layer 4 to 5 inches thick, and some areas of Torboy sandy loam and Nevine loam. Also included is Merkel stony sandy loam, which makes up about 8 percent of this unit. Runoff is very slow to medium, and the erosion hazard is slight or moderate. This soil is used for woodland, wildlife, and grazing. Capability unit IVe-2 nonirrigated; woodland subclass 4o.

MkE-Merkel sandy loam, 15 to 35 percent slopes. This moderately steep to steep soil is on mountainsides and at terrace edges. Runoff is medium or rapid, and the erosion hazard is moderate or severe. This soil is used as woodland and wildlife habitat. It also provides limit grazing. Capability subclass IVe nonirrigated ; woodland subclass 4o.

MkF-Merkel sandy loam, 35 to 65 percent slopes. This steep to very steep soil is on mountainsides. A few small areas of Edds soils are included in mapping. Runoff is rapid or very rapid, and the erosion hazard is severe or very severe. This soil is used for woodland, wildlife, and grazing. Capability subclass VIe nonirrigated ; woodland subclass 4r.

MlD-Merkel stony sandy loam, 0 to 25 percent slopes. This nearly level to moderately steep soil is on glacial till plains. It has a profile similar to the one described as representative of the series, but differs in having scattered stones and a few granite boulders about 10 to 40 feet apart on the surface. Included in mapping are areas of Torboy sandy loam, 15 to 25 percent slopes, and Scar sandy loam, 0 to 15 percent slopes. These included soils make up, respectively, about 8 and 5 percent of this unit. Runoff is slow or medium, and the erosion hazard is slight or moderate. This soil is used mainly for woodland, wildlife, and grazing. Capability unit VIe-2 nonirrigated; woodland subclass 40.

MlF-Merkel stony sandy loam, 25 to 65 percent slopes. This steep to very steep soil is on glacial till uplands. It has a profile similar to the one described as representative of the series, but differs in having scattered stones and granite boulders 10 to 40 feet apart on the surface. About 8 percent of this unit is included areas of Scar sandy loam. Also included are small areas of Rock land and a few areas of Torboy and Nevine soils. Runoff is rapid or very rapid, and the erosion hazard is severe or very severe. This soil is used as woodland and wildlife habitat. It also provides limited grazing. Capability unit VIIe-1 nonirrigated ; woodland subclass 4r.

MmE-Merkel-Rock land complex, 15 to 50 percent slopes. This moderately steep to very steep mapping unit is 40 to 70 percent Merkel stony sandy loam and 30 to 60 percent Rock land. Merkel soil has a profile similar to the one described as representative of the series, but differs in having stones on the surface. Rock land is 50 to 80 percent granite rock outcrop and 20 to 50 percent very shallow soils. A few small areas of Vallan and Scar soils are included in mapping. Runoff is medium to very rapid, and the erosion hazard is moderate to very severe. This mapping unit is used as woodland and wildlife habitat. It also provides limited grazing. Capability unit VIIs-1 nonirrigated ; woodland subclass 4r for Merkel soil, 5x for Rock land.

Mine Pits and Dumps

Mn-Mine pits and dumps consists of open pits or shafts and accumulations of waste rock or other debris associated with mining activity. Included in mapping are some undisturbed areas suited to grazing but too small to be productive as rangeland. Capability unit VIIIs-1 nonirrigated.

Mires Series

The Mires series consists of well-drained, nearly level soils formed in volcanic ash over glacial outwash. These soils are on terraces at elevations of 1,800 to 3,500 feet. The vegetation is mainly bluebunch wheatgrass, Idaho fescue, needlegrass, and scattered ponderosa pine. The annual precipitation is 14 to 17 inches. The mean annual air temperature is about 43° F. The frost-free period is 100 to 130 days. These soils are associated with the Chesaw, Hunters, Molson, and Republic soils.

In a representative profile, the surface layer is 14 inches of loam that is dark gray in the upper part and dark grayish brown in the lower part. Between depths of 14 and 21 inches is yellowish-brown gravelly sandy loam. The underlying material to a depth of 26 inches is pale-brown gravelly loamy sand and to a depth of 60 inches or more gravelly coarse sand.

Permeability is moderate. Available water capacity is low. Roots extend to a depth of 26 inches or more.

Mires soils are used for irrigated and nonirrigated hay, pasture, and small grain. They also provide grazing and sites for summer cabins.

Representative profile of Mires loam in cropland 390 feet south and 180 feet east of the northwest corner of NW1/4NW1/4 sec. 16, T. 37 N., R. 33 E.

Ap-0 to 6 inches, dark-gray (10YR 4/1) loam, black (10YR 2/1) moist; weak, fine, granular structure; soft, very friable, slightly plastic; many roots; 10 percent gravel; neutral; abrupt, smooth boundary. 6 to 8 inches thick.

A1-6 to 14 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak, medium, subangular blocky structure; soft, very friable, slightly plastic; many roots; many very fine pores; 10 percent gravel; neutral; abrupt, wavy boundary. 4 to 11 inches thick.

11B2-14 to 21 inches, yellowish-brown (10YR 5/4) gravelly sandy loam, dark yellowish brown (10YR 3/4) moist; weak, medium, subangular blocky structure; soft, very friable; common roots; many fine and very fine pores; 45 percent gravel; neutral; clear, wavy boundary. 7 to 10 inches thick.

IIC1-21 to 26 inches, pale-brown (10YR 6/3) gravelly loamy sand, dark brown (10YR 4/3) moist; massive; loose; common roots; 50 percent gravel and cobbles; neutral; abrupt, wavy boundary. 4 to 6 inches thick.

IIC2-26 to 60 inches, gravelly coarse sand; loose; 50 percent gravel and cobbles; neutral; lime coatings on underside of some coarse fragments. Many feet thick.

The content of coarse fragments by volume ranges from 10 to 50 percent. The A horizon is 10 to 19 inches thick. It is silt loam, loam, or sandy loam and in places is gravelly, cobbly, or stony. The B horizon is typically gravelly sandy loam, but in places is cobbly sandy loam. The C horizon ranges from gravelly loamy sand to gravelly coarse sand.

Mo-Mires loam. This is a nearly level soil on terraces. It has the profile described as representative of the series (fig. 4). A few small areas of gently sloping soils and soils that have a surface layer of sandy loam or gravelly loam are included in mapping. Runoff is very slow, and the hazard of erosion is slight. This soil is used for irrigated hay, pasture, and small grain. It also provides grazing and sites for summer cabins. Capability unit IVs-1 nonirrigated, IIIs-1 irrigated; Benchland range site ; woodland subclass 4o.

Mp-Mires gravelly loam. This is a nearly level soil on terraces and alluvial fans. It has a profile similar to the one described as representative of the series, but the surface layer is 20 to 35 percent gravel. Small areas of soil steeper than 3 percent and a soil that has a surface layer of sandy loam, gravelly silt loam, or gravelly sandy loam are included in mapping. Runoff is very slow, and the erosion hazard is slight. The soil is used for hay, pasture, small grain, and grazing. Capability unit IVs-1 nonirrigated, IIIs-1 irrigated; Benchland range site; woodland subclass 4o.

Mires Variant

This variant of the Mires series consists of well-drained, nearly level to steep soils formed in alluvium. These soils are on alluvial fans and terraces at elevations of 1,800 to 3,500 feet. The vegetation is mainly bluebunch wheatgrass, Idaho fescue, needlegrass, and scattered ponderosa pine. The annual precipitation is 14 to 17 inches. The mean annual air temperature is about 43° F. The frost-free period is 100 to 130 days.

In a representative profile, the uppermost 16 inches is sandy loam that is dark grayish brown in the upper part and brown in the lower part. Between depths of 16 and 22 inches is yellowish-brown sandy loam. The underlying material is light yellowish-brown loamy sand to a depth of 32 inches and multicolored gravelly

Figure 4.-Profile of nearly level Mires loam showing gravel and cobbles in the IIC horizons.

coarse sand to a depth of 60 inches or more. The underside of the gravel is coated with calcium carbonate.

Permeability is moderately rapid. Available water capacity is moderate. Roots extend to a depth of 60 inches or more.

The Mires variant is used for hay, pasture, small grain, and grazing. In places it is irrigated.

Representative profile of Mires sandy loam, alkaline subsoil variant, 1,452 feet north of the southeast corner of sec. 14, T. 39 N., R. 33 E. 5 percent slope, west aspect:

A11-0 to 4 inches, dark grayish-brown (10YR 4/2) sandy loam, very dark brown (10YR 2/2) moist; weak, thin, platy structure; soft, very friable, nonsticky and slightly plastic; many very fine roots; few fine pores; 5 percent fine gravel; neutral; clear, smooth boundary. 3 to 4 inches thick.

A12-4 to 9 inches, dark grayish-brown (10YR 4/2) sandy loam, very dark brown (10YR 2/2) moist; weak, fine, granular structure; soft, very friable, nonsticky and slightly plastic; many very fine roots; few fine pores; 5 percent fine gravel; mildly alkaline; clear, smooth boundary. 4 to 12 inches thick.

B21-9 to 16 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) moist; weak, medium, prismatic structure parting to weak, medium, subangular blocky structure; soft, very friable, nonsticky and slightly plastic; common very fine roots; few fine pores; 5 percent fine gravel; mildly

alkaline; clear, smooth boundary. 5 to 7 inches thick.

B22-16 to 22 inches, yellowish-brown (10YR 5/4) sandy loam, dark yellowish brown (10YR 3/4) moist; weak, medium, prismatic structure; soft, very friable, nonsticky and slightly plastic; common very fine roots; few fine pores; 5 percent fine gravel; mildly alkaline; clear, smooth boundary. 5 to 9 inches thick.

C1-22 to 32 inches, light yellowish-bro' m (10YR 6/4) loamy sand, dark yellowish brown (10YR 3/4) moist; massive; soft, very friable, nonsticky and nonplastic; common very fine roots; few fine pores; 5 percent fine gravel; moderately alkaline; abrupt, wavy boundary. 8 to 15 inches thick.

C2-32 to 60 inches, multicolored gravelly coarse sand; loose; few very fine roots; 15 to 20 percent gravel and some cobbles; underside of gravel is coated with calcium carbonate; moderately alkaline.

The A and B horizons contain a minor amount of volcanic ash and fine gravel. The A horizon ranges from dark grayish brown to grayish brown. The B horizon is brown or yellowish brown. The C horizon is loamy sand, sand, or gravelly sand.

MrC-Mires sandy loam, alkaline subsoil variant, 0 to 15 percent slopes. This nearly level to strongly sloping soil is on terraces and old alluvial fans. It has the profile described as representative of the variant. Approximately 25 percent of the total acreage of this mapping unit is included areas where the slope is more than 15 percent and the surface layer is loamy sand. Runoff is very slow to medium, and the erosion hazard is slight or moderate. This soil is used for irrigated alfalfa, grass, and small grain and for grazing. Capability unit IVe-1 nonirrigated, IIIe-1 irrigated; Benchland range site; woodland subclass 4o.

MrE-Mires sandy loam, alkaline subsoil variant, 25 to 45 percent slopes. This steep soil is on the sides of terraces. Included in mapping are small areas where the surface layer is loamy sand or silt loam. Runoff is rapid, and the erosion hazard is severe. The entire acreage is used for grazing. Capability unit VIe-1 nonirrigated; Benchland range site; woodland subclass 4r.

Mixed Alluvial Land

Ms-Mixed alluvial land consists of nearly level areas of unconsolidated alluvium deposited recently by streams. The alluvium is generally stratified and ranges widely in texture. It is subject to frequent changes caused by stream overflow, but has been in place long enough for vegetation to become established. Old stream channels are common. The vegetation is mostly cottonwood, spruce, scattered Douglas-fir, brush, and grasses. Capability unit VIIIw-1 nonirrigated.

Molcal Series

The Molcal series consists of well-drained, nearly level to steep soils formed in volcanic ash over glacial till derived mainly from calcareous argillite, quartzite, and gneiss. These soils are on uplands at elevations of 1,500 to 3,000 feet. The vegetation is mainly ponderosa pine, bunchgrass, snowberry, and, on northern exposures, Douglas-fir. The annual precipitation is 17 to 20 inches. The mean annual air temperature is about 45° F. The frost-free period is 100 to 130 days. Molcal soils are associated with Stevens soils.

In a representative profile, the upper 17 inches is dark-gray silt loam. Below this is 12 inches of light brownish-gray gravelly silt loam. Between depths of 29 and 60 inches is light-gray or gray gravelly silt loam. The soil is calcareous and moderately alkaline.

Permeability is moderately slow. Available water capacity is high. Roots extend to a depth of 60 inches or more.

Molcal soils are used for hay, small grain, grazing, and wildlife.

Representative profile of Molcal stony silt loam, 1,980 feet south and 1,150 feet east of the northeast corner of sec. 19, T. 35 N., R. 37 E. 22 percent slope, south-southeast aspect, 1,800 feet elevation

Ap-0 to 6 inches, dark-gray (10YR 4/1) stony silt loam, black (10YR 2/1) moist; weak, very fine and fine, granular structure; soft, very friable, nonsticky and slightly plastic; many very fine roots; scattered stones averaging about 1 foot in diameter cover about 2 percent of the surface; 2 to 5 percent shaly material; violently effervescent; moderately alkaline; clear, smooth boundary. 6 to 8 inches thick.

A1-6 to 17 inches, dark-gray (10YR 4/1) silt loam, black (10YR 2/1) moist; weak, medium, subangular blocky structure; soft, very friable, nonsticky and slightly plastic; many very fine roots; 2 to 5 percent shaly material; violently effervescent; moderately alkaline; abrupt, wavy boundary. 8 to 12 inches thick.

IIC1ca-17 to 29 inches, light brownish-gray (2.5Y 6/2) gravelly silt loam, dark grayish brown (2.5Y 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; common very fine pores; moderately thick calcium carbonate in pores; 20 to 30 percent gravel; violently effervescent; moderately alkaline; gradual, wavy boundary. 10 to 14 inches thick.

IIC2ca-29 to 60 inches, light-gray or gray (5Y 6/1) gravelly silt loam, dark gray (5Y 4/1) moist; massive; hard, friable, sticky and plastic; few very fine roots; few very fine pores; moderately thick calcium carbonate in pores; 20 to 30 percent gravel; violently effervescent; moderately alkaline.

The A horizon is stony or nonstony. The C horizon is gravelly silt loam or gravelly clay loam.

MtB-Molcal silt loam, 0 to 8 percent slopes. This is a nearly level to gently sloping soil on concave uplands. It has a profile similar to the one described as representative of the series, but it is nonstony and the dark-gray surface layer is 17 to 20 inches thick. Runoff is very slow or slow, and the erosion hazard is slight. This soil is used for alfalfa, wheat, barley, and grazing. Capability unit IIIe-1 nonirrigated; Loamy range site.

MtD-Molcal silt loam, 8 to 25 percent slopes. This is a strongly sloping to moderately steep soil on uplands. It has a profile similar to the one described as representative of the series, but it is nonstony. Included in mapping are areas where limy argillite bedrock is at a depth of 19 to 26 inches. Runoff is medium, and the erosion hazard is moderate. This soil is used for grasses, alfalfa, wheat, and barley. Capability unit IVe-1 nonirrigated; Loamy range site.

MuE-Molcal stony silt loam, 0 to 45 percent slopes. This is a nearly level to steep soil on uplands. It has the profile described as representative of the series. About 10 percent of this unit is included areas of a nonstony Molcal soil, and 7 percent is areas of limy argillite rock outcrop and shaly colluvial material on very steep slopes. Runoff is slow to rapid, and the ero-

sion hazard is slight to severe. All the acreage is used for grazing and wildlife. Capability unit VIe-1 nonirrigated; Loamy range site.

Molson Series

The Molson series consists of well-drained, nearly level to steep soils formed in volcanic ash over glacial till. These soils are in mountain valleys and on mountain uplands at elevations of 1,900 to 4,500 feet. The native vegetation is mainly ponderosa pine, Idaho fescue, bluebunch wheatgrass, ninebark, and snowberry. The annual precipitation is 14 to 18 inches. The mean annual air temperature is about 43° F. The frost-free period is 95 to 135 days. Molson soils are associated with Donavan, Hunters, Koepke, Mires, and Republic soils.

In a representative profile, a 2-inch mat of needles and twigs is at the surface. Next, in sequence downward, is 10 inches of very dark gray loam, 8 inches of dark grayish-brown loam, 4 inches of brown loam, and 32 inches of pale-brown or very pale brown gravelly loam. Below this to a depth of 60 inches or more is light-gray gravelly loam. The acidity of this soil decreases with increasing depth.

Permeability is moderate. Available water capacity is low to high. Roots penetrate to a depth of 60 inches or more.

Molson soils are used for small grain, hay, grasses, grazing, and woodland.

Representative profile of Molson stony loam, 25 to 40 percent slopes, in an area 800 feet south and 1,075 feet east of the northwest corner of sec. 20, T. 37 N., R. 33 E.

O1-2 inches to 0, needles and twigs.

A11-0 to 10 inches, very dark gray (10YR 3/1) stony loam, black (10YR 2/1) moist; weak, very fine, granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; stones averaging 1 foot in diameter cover about 2 percent of the surface; slightly acid; clear, smooth boundary. 6 to 10 inches thick.

A12-10 to 18 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak, very fine, granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine to coarse roots; slightly acid; abrupt, wavy boundary. 8 to 12 inches thick.

B21-18 to 22 inches, brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; weak, fine, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine to medium roots; common very fine pores; 10 to 20 percent gravel and cobbles; neutral; abrupt, wavy boundary. 4 to 9 inches thick.

IIB22-22 to 28 inches, pale-brown (10YR 6/3) gravelly loam, brown or dark brown (10YR 4/3) moist; weak, fine or medium, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine to medium roots; common very fine pores; 15 to 20 percent gravel and cobbles; neutral; clear, smooth boundary. 5 to 18 inches thick.

IIC1-28 to 54 inches, very pale brown (10YR 7/3) gravelly loam, brown (10YR 5/3) moist; massive; hard, friable, slightly sticky and slightly plastic; very few roots; few very fine pores; 30 to 40 percent gravel; mildly alkaline; gradual, wavy boundary. 12 to 30 inches thick.

IIC2-54 to 60 inches, light-gray (2.5Y 7/2) gravelly loam, grayish brown (2.5Y 5/2) moist; massive, slightly hard, friable, slightly sticky and slightly plastic; very few fine roots; few very fine pores; 30 to 40 percent gravel; moderately alkaline.

On southern exposures the A horizon is typically dark grayish brown and 12 to 16 inches thick. On northern exposures it is very dark gray and 14 to 22 inches thick. It is stony or nonstony loam or silt loam. The B horizon is brown, yellowish-brown, or pale-brown loam, gravelly loam, or silt loam.

MvB-Molson loam, 0 to 8 percent slopes. This nearly level to gently sloping soil is on uplands. It has a profile similar to the one described as representative of the series, but it is nonstony. Runoff is slow or very slow, and the erosion is slight. The soil is used for hay (fig. 5), small grain, and pasture. Available water capacity is moderate to high. Capability unit IIIe-1 nonirrigated; Loamy range site; woodland subclass 3o.

MvC-Molson loam, 8 to 15 percent slopes. This strongly sloping soil is on rounded hilltops. It has a profile similar to the one described as representative of the series, but it is nonstony. Runoff is medium, and the hazard of erosion is moderate. Available water capacity is moderate to high. This soil is used for hay, small grain, and pasture. Capability unit IIIe-1 nonirrigated ; Loamy range site ; woodland subclass 3o.

MvD-Molson loam, 15 to 25 percent slopes. This moderately steep soil is on hillsides. It has a profile similar to the one described as representative of the series, but it is nonstony. Included in mapping are small areas where the soil is moderately well drained and the surface layer is moderately alkaline. Runoff is medium, and the erosion hazard is moderate. Available water capacity is moderate to high. This soil is used for hay, small grain, pasture, grazing, and woodland. Capability unit IVe-1 nonirrigated; Loamy range site; woodland subclass 3o.

MvE-Molson loam, 25 to 45 percent slopes. This steep soil is in mountainous areas. It has a profile similar to the one described as representative of the series, but it is nonstony. Included in mapping are small areas of rock outcrop and stony soil. Runoff is rapid, and the erosion hazard is severe. Available water capacity is moderate to high. The entire acreage is used for grazing and woodland. Capability unit VIe-1 nonirrigated ; Loamy range site ; woodland subclass 3r.

MwD-Molson gravelly loam, 0 to 25 percent slopes. This nearly level to moderately steep soil is on uplands. It has a profile similar to the one described as representative of the series, but the surface layer is nonstony, is 20 to 35 percent gravel, and is generally dark brown. Included in mapping are small areas where the surface layer is loam or gravelly sandy loam. Runoff is slow or medium, and the erosion hazard is slight or moderate. Available water capacity is low to moderately high. This soil is used for small grain, hay, pasture, grazing, and woodland. Capability unit IVe-1 nonirrigated ; Loamy range site ; woodland subclass 3o.

MxE-Molson stony loam, 25 to 40 percent slopes. This steep soil is on the uplands below rocky ridges and above less steep Molson soils. It has the profile described as representative of the series. Stones cover about 2 percent of the surface area. Runoff is rapid, and the erosion hazard is severe. Available water capacity is moderate to high. This soil is used for grazing, woodland, and wildlife. Capability unit VIe-1 nonirrigated; Loamy range site; woodland subclass 3r.

MyE-Molson-Rock land complex, 15 to 50 percent

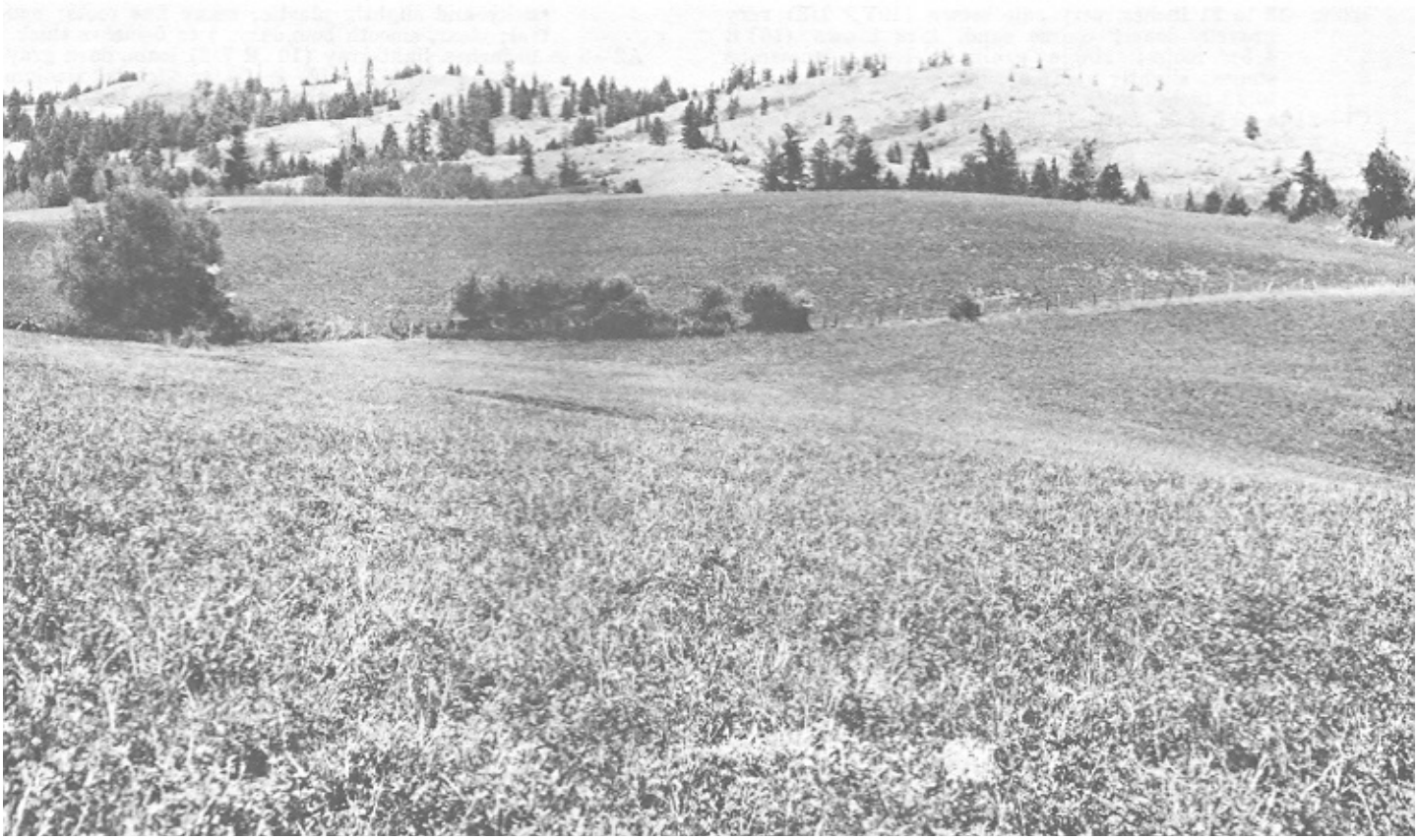

Figure 5.-Dryland alfalfa grown for hay on Molson loam, 0 to 8 percent slopes. Vallan soils are in the background.

slopes. This moderately steep to very steep mapping unit is 55 to 80 percent Molson soil and 20 to 45 percent Rock land. It is on rough ridges and hilltops. Rock land is 50 to 90 percent rock outcrop and 10 to 50 percent very shallow soils. Runoff is medium to very rapid, and the erosion hazard is moderate to very severe. Available water capacity of the Molson soil is moderate to high. This mapping unit is used for grazing, woodland, and wildlife. Capability unit VIIs-1 nonirrigated; Loamy range site; woodland subclass 3r for Molson soil, 5x for Rock land.

Nanamkin Series

The Nanamkin series consists of somewhat excessively drained, nearly level to strongly sloping soils formed in sandy glacial outwash. These soils are on valley terraces at elevations of 2,500 to 3,500 feet. The vegetation is mainly ponderosa pine and Douglas-fir and an understory of pinegrass, snowberry, and kinnikinnick. The annual precipitation is 20 to 25 inches. The mean annual air temperature is about 42° F. The frost-free period is 110 to 130 days. Nanamkin soils are associated with Goddard, Karamin, Merkel, Nevine, and Torboy soils.

In a representative profile, a thin layer of forest litter is at the surface. The surface layer is light-gray gravelly sandy loam about 5 inches thick. Next, in sequence downward, is 16 inches of very pale brown very gravelly loamy sand and loamy coarse sand, 8 inches of stratified white very gravelly loamy coarse sand, 8 inches of light-gray loamy sand, 2 inches of white pumicite, and 7 inches of very pale brown gravelly loamy coarse sand. Below this to a depth of 60 inches or more is light-gray sand and gravel.

Permeability is rapid. Available water capacity is very low. Roots penetrate to a depth of 40 to 60 inches.

Nanamkin soils are used as woodland and big game and grouse habitat. They also provide grazing.

Representative profile of Nanamkin gravelly sandy loam, 0 to 15 percent slopes, in a forested area, NW1/4 SW1/4 sec. 32, T. 36 N., R. 34 E., 15 yards north and 150 yards west of O'Brien Creek, Inchelium road junction, South Fork O'Brien Creek:

O2-1 inch to 0, partly decomposed leaves, twigs, and needles.

A2-0 to 5 inches, light-gray (10YR 7/2) gravelly sandy loam, dark grayish brown (10YR 4/2) moist; very weak, coarse, granular structure; soft, very friable, nonsticky and nonplastic ; many fine roots ; strongly acid; clear, smooth boundary. 1 inch to 6 inches thick.

B21ir-5 to 12 inches, very pale brown (10YR 7/4) very gravelly loamy sand, dark yellowish brown (10YR 4/4) moist; massive; slightly compact and friable, slightly hard, nonsticky and nonplastic; many fine roots; medium acid; clear, wavy boundary. 6 to 10 inches thick.

B22ir-12 to 21 inches, very pale brown (10YR 7/3) very gravelly loamy coarse sand, dark brown (10YR 4/3) moist; single grained; loose; numerous stones; slightly acid; abrupt, smooth boundary. 8 to 12 inches thick.

C1-21 to 29 inches, white (10YR 8/2) very gravelly loamy coarse sand, yellowish brown (10YR 5/4) moist; massive; slightly hard, friable, nonsticky and nonplastic; slightly acid; clear, irregular boundary. 5 to 10 inches thick.

IIC2-29 to 37 inches, light-gray (10YR 7/2) loamy sand, pale brown (10YR 6/3) moist; massive; slightly compact; 70 percent stones and gravel; slightly acid; abrupt, wavy boundary. 6 to 10 inches thick.

IIIC3-37 to 39 inches, white (10YR 8/2) pumicite, very pale brown (10YR 8/3) moist; massive; slightly hard, friable, nonsticky and nonplastic; mat of roots; medium acid; abrupt, wavy boundary. 2 to 4 inches thick.

IVB2b-39 to 46 inches, very pale brown (10YR 7/4) gravelly loamy coarse sand, yellowish brown (10YR 5/4) moist; massive; slightly hard, firm, slightly sticky and nonplastic; medium acid; clear, wavy boundary. 5 to 8 inches thick.

VC4-46 to 60 inches, light-gray extremely stony sand and gravel; slightly compact; 70 percent stones and boulders.

The content of coarse fragments between depths of 10 and 40 inches exceeds 50 percent by weighted average. The A2 horizon is gravelly sandy loam or gravelly loamy sand and is medium acid or strongly acid. The Bir and C1 horizons range from slightly acid to strongly acid.

NaC-Nanamkin gravelly sandy loam, 0 to 15 percent slopes. This is a nearly level to strongly sloping soil on terraces. It has the profile described as representative of the series. Runoff is slow or medium, and the erosion hazard is slight or moderate. This soil is used for woodland, wildlife, and grazing. Capability subclass VIe nonirrigated; woodland subclass 2f.

Neuske Series

The Neuske series consists of moderately well drained, moderately steep to very steep soils formed in silty glacial till. These soils are on hillsides and ground moraines at elevations of 3,500 to 4,500 feet. The vegetation is mainly Douglas-fir, subalpine fir, ninebark, and snowberry. The annual precipitation is 25 to 30 inches. The mean annual air temperature is about 43° F. The frost-free period is about 120 days. Neuske soils are associated with Aits and Nevine soils.

In a representative profile, the upper 5 inches is grayish-brown silt loam. Next, in sequence downward, is 5 inches of light-gray loam, 19 inches of very pale brown clay loam, 5 inches of light-gray clay loam, and 12 inches of brown gravelly clay loam. Below this to a depth of 60 inches is grayish-brown very stony clay loam.

Permeability is moderately slow. Available water capacity is high. Roots penetrate to a depth of 40 to 60 inches.

Neuske soils are used as woodland and big game and grouse habitat. They also provide limited grazing.

Representative profile of Neuske silt loam, 15 to 35 percent slopes, in a forested area, SWl/4SW1/4 sec. 20, T. 37 N., R. 34 E. Timber Ridge logging road, Republic Ranger District, Colville National Forest, 20 yards uphill from road:

A1-0 to 5 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak, medium, blocky structure; soft, friable, slightly sticky and slightly plastic; many fine roots; neutral; clear, smooth boundary. 4 to 6 inches thick.

A2-5 to 10 inches, light-gray (10YR 7/2) loam, dark grayish brown (10YR 4/2) moist; moderate, medium, subangular blocky structure; slightly hard, firm, slightly sticky and slightly plastic; many fine roots; slightly acid; abrupt, smooth boundary. 4 to 6 inches thick.

B2-10 to 29 inches, very pale brown (10YR 7/3) clay loam, dark brown (10YR 4/3) moist; massive; very hard, very firm, sticky and plastic; few fine roots; few pebbles and stones; slightly acid; abrupt, smooth boundary. 16 to 20 inches thick.

A'2-29 to 34 inches, light-gray (10YR 7/2) clay loam, brown (10YR 5/3) moist; massive; very hard, very firm, sticky and plastic; few fine roots; common tubular pores; few pebbles and stones; neutral; abrupt, smooth boundary. 4 to 8 inches thick.

B'2t-34 to 46 inches, brown (10YR 5/3) gravelly clay loam, dark brown (10YR 4/3) moist; massive; very hard, very firm, sticky and plastic ; many decayed roots; many pebbles and stones; common, thin, continuous clay films in pores; neutral; abrupt, smooth boundary. 10 to 14 inches thick.

B'3ca-46 to 60 inches, grayish-brown (10YR 5/2) very stony clay loam, dark grayish brown (10YR 4/2) moist; massive; very hard, firm, sticky and plastic; 25 percent stones; seams and coatings of lime; mildly alkaline.

Between depths of 10 to 40 inches, reaction ranges from neutral to medium acid and the soil is 5 to 35 percent coarse fragments, 27 to 35 percent clay, and more than 15 percent material coarser than very fine sand. The Al horizon is silt loam, loam, or clay loam. The A2 horizon is loam, silt loam, or clay loam. The B horizon ranges from loam to clay loam or silty clay loam. The A'2 horizon ranges from loam to silty clay loam or clay loam and in places is gravelly. The B'2 horizon is gravelly clay loam or gravelly silty clay loam.

NeE-Neuske silt loam, 15 to 35 percent slopes. This moderately steep to steep soil is on mountainsides. It has the profile described as representative of the series. Included in mapping are a few areas of Edds soil. Runoff is medium or rapid, and the erosion hazard is moderate or severe. This soil is used as woodland and wildlife habitat. It also provides limited grazing. Capability subclass IVe nonirrigated; woodland subclass 3o.

NeF-Neuske silt loam, 35 to 65 percent slopes. This steep to very steep soil is on mountainsides. Included in mapping are small areas of moderately steep soil. Runoff is rapid or very rapid, and the erosion hazard is severe or very severe. This soil is used as woodland and wildlife habitat. Capability subclass VIe nonirrigated; woodland subclass 3r.

Nevine Series

The Nevine series consists of well-drained, nearly level to very steep soils formed in volcanic ash over compact glacial till. These soils are on mountainous uplands at elevations of 2,500 to 5,500 feet. The vegetation is mainly Douglas-fir and ponderosa pine and an understory of pinegrass, ninebark, snowberry, and pachistima. The annual precipitation is 17 to 24 inches. The mean annual air temperature is about 43° F. The frost-free period is 90 to 120 days. Nevine soils are associated with Anglen, Donavan, Merkel, and Talls soils.

In a representative profile, a thin layer of organic litter is at the surface. Next, in sequence downward, is 6 inches of light brownish-gray and pale-brown loam, 11 inches of very pale brown loam, and 15 inches of light-gray gravelly loam. Below this to a depth of 60

inches or more is weakly cemented light-gray gravelly sandy loam or gravelly coarse sandy loam.

Permeability is moderate. Available water capacity is low or moderate. Roots penetrate to a depth of 60 inches or more.

Nevine soils are used as woodland and big game and grouse habitat. They also provide limited grazing.

Representative profile of Nevine loam, 0 to 30 percent slopes, in a forested area 2,112 feet west and 528 feet north of southeast corner of sec. 1, T. 36 N., R. 31 E.

O2-1 inch to 0, partly decomposed needles, twigs, and grass; neutral.

A2-0 to 1/4 inch, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; soft, very friable; slightly acid; abrupt, smooth boundary. 0 to 3/4 inch thick.

B21-1/4 inch to 6 inches, pale-brown (10YR 6/3) loam, brown (10YR 4/3) moist; weak, fine, subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many roots; few fine pores; neutral; clear, smooth boundary. 5 to 9 inches thick.

B22-6 to 17 inches, very pale brown (10YR 7/4) loam, dark yellowish brown (10YR 4/4) moist; weak, medium, subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many roots; few fine pores; slightly acid; abrupt, wavy boundary. 9 to 17 inches thick.

IIC1-17 to 32 inches, light-gray (2.5Y 7/2) gravelly loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common roots; few fine pores; 35 percent gravel and 20 percent cobbles and stones; slightly acid; clear, smooth boundary. 10 to 20 inches thick.

IIC2-32 to 50 inches, light-gray (2.5Y 7/2) gravelly sandy loam, grayish brown (2.5Y 5/2) moist; massive; weakly cemented, but crumbles easily when wet; hard, friable, slightly sticky and slightly plastic; few roots; few fine pores; few prominent bands, 1 millimeter to 5 millimeters wide, brown (10YR 4/3) moist; 35 percent gravel and 20 percent cobbles and stones; slightly acid; abrupt, smooth boundary. 10 to 24 inches thick.

IIIC3-50 to 60 inches, light-gray (2.5Y 7/2) gravelly coarse sandy loam, grayish brown (2.5Y 5/2) moist; massive; weakly cemented when dry, but crumbles easily when wet; slightly hard, friable; few roots; common fine pores; 35 percent gravel and 20 percent cobbles and stones; slightly acid.

The A and B horizons are less than 15 percent coarse fragments. The B horizon is silt loam or loam. The C horizon is loam, sandy loam, or fine sandy loam and is gravelly or cobbly.

NlD-Nevine loam, 0 to 30 percent slopes. This is a nearly level to steep soil on hilly uplands. It has the profile described as representative of the series. Runoff is slow to rapid, and the erosion hazard is slight to severe. This soil is used as woodland and wildlife habitat. It also provides limited grazing. Capability unit IVe-2 nonirrigated ; woodland subclass 3o.

NlE-Nevine loam, 30 to 45 percent slopes. This is a steep soil on mountainous uplands. Included in mapping are areas of Anglen, Talls, and Oxerine soils, which make up about 15 percent of this unit. Runoff is rapid or very rapid, and the erosion hazard is severe or very severe. This soil is used for woodland, wildlife, and grazing. Capability unit VIe-2 nonirrigated; woodland subclass 3r.

NlF-Nevine loam, 45 to 65 percent slopes. This is a very steep soil on mountainsides. Included in mapping are small areas where the slope is greater than 65 percent and bedrock is exposed. Runoff is very rapid, and the erosion hazard is very severe. This soil is used as woodland and wildlife habitat. Capability unit VIIe-1 nonirrigated; woodland subclass 3r.

NnD-Nevine stony loam, 0 to 25 percent slopes. This is a nearly level to moderately steep soil on uplands. It has a profile similar to the one described as representative of the series, but about 2 percent of the surface area is covered with large stones and a few boulders. Included in mapping are a few areas where bedrock is exposed. Runoff is slow or medium, and the erosion hazard is slight to severe. This soil is used for woodland, wildlife, and grazing. Capability unit VIe-2 nonirrigated ; woodland subclass 4o.

NnF-Nevine stony loam, 25 to 65 percent slopes. This is a steep to very steep soil in mountainous areas. Included in mapping are areas where bedrock is exposed, areas where the soil formed in colluvium, small areas of a nonstony Nevine soil, and small areas of Anglen, Talls, and Torboy soils. Runoff is rapid or very rapid, and the erosion hazard is severe or very severe. This soil is used for woodland, wildlife, and grazing. Capability unit VIIe-1 nonirrigated; woodland subclass 4r.

NoE-Nevine silt loam, 15 to 35 percent slopes. This is a moderately steep to steep soil on mountainsides. It has a profile similar to the one described as representative of the series, but the upper 6 to 10 inches differs in texture. Included in mapping are a few terrace edges where the slope is more than 35 percent. Runoff is medium or rapid, and the erosion hazard is moderate or severe. This soil is used for woodland, wildlife, and grazing. Capability subclass IVe nonirrigated ; woodland subclass 3o.

NrE-Nevine-Rock land complex, 15 to 50 percent slopes. This moderately steep to very steep mapping unit is approximately 50 percent Nevine soil and 50 percent Rock land. It is on mountaintops, ridges, and side slopes in mountainous uplands. Rock land is 50 to 90 percent rock outcrop and 10 to 50 percent very shallow soils. Runoff is medium to very rapid, and the erosion hazard is moderate or severe. This mapping unit is used for grazing, woodland, and wildlife. Capability unit VIIs-1 nonirrigated ; woodland subclass 4r for Nevine soil, 5x for Rock land.

Oxerine Series

The Oxerine series consists of well-drained, nearly level to very steep soils formed in volcanic ash over glacial till and underlain by bedrock at a depth of 20 to 40 inches. These soils are on mountainous uplands at elevations of 2,000 to 4,000 feet. The vegetation is mainly Douglas-fir and ponderosa pine and an understory of Idaho fescue, oceanspray, mockorange, and ninebark. The annual precipitation is 27 to 33 inches. The mean annual air temperature is about 43° F. The frost-free period is 90 to 120 days. Oxerine soils are associated with Pepoon, Cobey, Edds, Merkel, and Nevine soils.

In a representative profile, a thin layer of forest litter is at the surface. Next, in sequence downward, is 4 inches of brown loam, 6 inches of pale-brown gravelly loam, 9 inches of pale-brown very gravelly loam, and 5 inches of pale-brown very flaggy sandy loam. Bedrock is at a depth of about 24 inches.

Permeability is moderate. Available water capacity is low or very low. Roots penetrate as far down as bedrock.

Oxerine soils are used as woodland and big game and grouse habitat. They also provide grazing.

Representative profile of Oxerine loam, 0 to 15 percent slopes, in a forested area, NW1/4SE1/4 sec. 25, T. 87 N., R. 36 E., on crest or ridge at bend in forest road as it heads north:

O1-1 inch to 0, litter of needles, twigs, and grass.

A1-0 to 4 inches, brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; weak, fine, subangular blocky structure; soft, friable, nonsticky and nonplastic; common fine and medium roots; few fine tubular pores; 10 percent gravel and 5 percent flagstones; common fine charcoal fragments; neutral; clear, wavy boundary. 0 to 4 inches thick.

B21ir-4 to 10 inches, pale-brown (10YR 6/3) gravelly loam, dark yellowish brown (10YR 4/4) moist; weak, fine, subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; common fine and medium roots; few fine tubular pores; 20 percent gravel and 10 percent flagstones; common fine charcoal fragments; neutral; clear, wavy boundary. 4 to 10 inches thick.

B22ir-10 to 19 inches, pale-brown (10YR 6/3) very gravelly loam, brown (10YR 5/3) moist; weak, fine and medium, subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; common fine and medium roots; few fine tubular pores; 50 percent gravel and 10 percent flagstones; few fine charcoal fragments; slightly acid; clear, wavy boundary. 6 to 14 inches thick.

IIB3-19 to 24 inches, pale-brown (10YR 6/3) very flaggy sandy loam, brown (10YR 5/3) moist; massive; hard, very friable, slightly sticky and slightly plastic; common medium roots; few fine tubular pores; 70 percent flagstones and stones and 15 percent gravel; few fine charcoal fragments; slightly acid; abrupt, wavy boundary. 4 to 12 inches thick.

R-24 inches, gneiss, schist, and quartzite bedrock.

The Al, B2ir and B21ir horizons are more than 60 percent volcanic ash in the fine earth fraction. The IIB3 horizon is more than 50 percent coarse fragments. Depth to bedrock ranges from 20 to 40 inches. The A1 horizon is loam or silt loam and in places is gravelly, stony, or cobbly. The IIB3 horizon is sandy loam or loam and is very flaggy, very gravelly, or very cobbly. The R horizon is gneiss, schist, and quartzite.

OlC-Oxerine loam, 0 to 15 percent slopes. This nearly level to strongly sloping soil is in basins. It has the profile described as representative of the series. Runoff is very slow to medium, and the erosion hazard is slight or moderate. This soil is used for woodland, wildlife, and grazing. Capability subclass IVe nonirrigated; woodland subclass 3d.

OlE-Oxerine loam, 15 to 35 percent slopes. This moderately steep to steep soil is in mountain basins. Runoff is medium or rapid, and the erosion hazard is moderate or severe. This soil is used for woodland, wildlife, and grazing. Capability subclass IVe nonirrigated; woodland subclass 3d.

OlF-Oxerine loam, 35 to 65 percent slopes. This steep to very steep soil is in mountainous areas. Runoff is rapid or very rapid, and the erosion hazard is severe or very severe. This soil is used as woodland and wildlife habitat. Capability subclass VIe nonirrigated; woodland subclass 3d.

OnE-Oxerine-Edds complex, 15 to 50 percent slopes. This moderately steep to very steep mapping unit is on mountain uplands. It is 55 to 65 percent Oxerine soil and 35 to 45 percent Edds soil. The Edds soil is described under the heading Edds Series. Runoff is medium to very rapid, and the erosion hazard is moderate to very severe. This mapping unit is used for woodland, wildlife, and grazing. Capability subclass VIe nonirrigated; woodland subclass 3d for Oxerine soil, 3r for Edds soil.

OpE-Oxerine-Pepoon complex, 15 to 35 percent slopes. This moderately steep to steep mapping unit is on uplands. It is approximately 55 to 65 percent Oxerine soil and 35 to 45 percent Pepoon soil. The Pepoon soil has the profile described as representative of the Pepoon series. Small areas of Growden soil are included in mapping. Runoff is medium or rapid, and the erosion hazard is moderate or severe. This mapping unit is used for woodland, wildlife, and grazing. Capability subclass VIe nonirrigated ; Shallow range site; woodland subclass 3d for Oxerine soil, 5x for Pepoon soil.

OpF-Oxerine-Pepoon complex, 35 to 65 percent slopes. This steep to very steep mapping unit is in mountainous areas. It is approximately 55 to 65 percent Oxerine soil and 35 to 45 percent Pepoon soil. The Pepoon soil is described under the heading Pepoon Series. Runoff is rapid or very rapid, and the erosion hazard is severe or very severe. This mapping unit is used for woodland, wildlife, and grazing. Capability subclass VIe nonirrigated; Shallow range site; woodland subclass 3d for Oxerine soil, 5x for Pepoon soil.

OrE-Oxerine-Rock land complex, 15 to 50 percent slopes. This moderately steep to steep mapping unit is on mountain uplands. It is 40 to 70 percent Oxerine soil and 30 to 60 percent Rock land. The Rock land is 50 to 90 percent rock outcrop and 10 to 50 percent very shallow soils. Runoff is medium to very rapid, and the erosion hazard is moderate to very severe. This mapping unit is used for woodland, wildlife, and grazing. Capability subclass VIIs nonirrigated ; woodland subclass 3d for Oxerine soil, 5x for Rock land.

Pausant Series

The Pausant series consists of well-drained, nearly level to very steep soils formed in stratified sand and silty glacial lake deposits. These soils are on terraces and terrace escarpments in mountain valleys at elevations of 2,000 to 3,000 feet. The vegetation is mainly Douglas-fir and ponderosa pine and an understory of snowberry, ninebark, and pinegrass. The annual precipitation is 16 to 25 inches. The mean annual temperature is 41° to 43° F. The frost-free period is 90 to 120 days. Pausant soils are associated with Karamin, Merkel, Nevine, and Talls soils.

In a representative profile, a thin layer of roots, leaves, and twigs is at the surface. Next is 52 inches of fine sandy loam that is grayish brown in the upper 6 inches, very pale brown in the next 9 inches, and light gray in the lower 37 inches. Below this is 3 inches of light brownish-gray sandy clay loam. This layer is underlain by white clay and light-gray fine sand to a depth of 89 inches or more.

Permeability is moderate as far down as the sandy clay loam or clay and moderately slow below. Available water capacity is moderately high or high. Roots penetrate to a depth of 40 to 60 inches.

Pausant soils are used for woodland, wildlife, and grazing.

Representative profile of Pausant fine sandy loam, 0 to 15 percent slopes, in a forested area, SE1/4NW1/4 sec. 33, T. 36 N., R. 36 E., on terrace just above and south of South Fork Sherman Creek Road after it crosses bridge south from Sherman Peak Pass Highway:

O1-1 inch to 0, roots, leaves, and twigs.

A1-0 to 6 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak, fine and medium, granular structure; loose, very friable, nonsticky and nonplastic; many fine roots; slightly acid; clear, smooth boundary. 5 to 7 inches thick.

B21ir-6 to 12 inches, very pale brown (10YR 7/4) fine sandy loam, dark brown (10YR 4/3) moist; very weak, fine and medium, subangular blocky structure; loose, very friable, nonsticky and nonplastic; mat of fine roots at lower boundary; medium acid; clear, smooth boundary. 5 to 7 inches thick.

A21-12 to 15 inches, very pale brown (10YR 7/3) fine sandy loam, brown (10YR 5/3) moist; weak, medium, subangular blocky structure; loose, friable, nonsticky and nonplastic; many fine roots, with root mat at lower boundary; strongly acid; clear, wavy boundary. 3 to 5 inches thick.

A22-15 to 35 inches, light-gray (10YR 7/2) fine sandy loam, light brownish gray (10YR 6/2) moist; single grained; hard, firm, nonsticky and nonplastic; few fine roots; few discontinuous and thin, wavy, brown iron bands in upper part of horizon ; bands more than 1 centimeter thick total more than 2 centimeters of horizon; few fine pebbles; medium acid; clear, wavy boundary. 14 to 18 inches thick.

B21-35 to 52 inches, light-gray (10YR 7/1) fine sandy loam, light brownish gray (10YR 6/2) moist; single grained; very hard, very firm, nonsticky and nonplastic; two 1- to 2-inch bands of light sandy clay loam, about 6 inches apart, dark grayish brown (10YR 4/2) moist; several 1/8-1/16-inch wavy bands of brown sandy clay in upper part of horizon; bands more than 1 centimeter thick total 9 centimeters of horizon; main mass neutral; bands are medium acid; clear, wavy boundary. 16 to 20 inches thick.

B22t-52 to 55 inches, light brownish-gray (10YR 6/2) sandy clay loam, dark grayish brown (10YR 4/2) moist; massive; very hard, very firm, sticky and plastic; thin clay films in pores; slightly acid; clear, smooth boundary. 1/16 inch to 4 inches thick.

IIA'2-55 to 59 inches, white (10YR 8/2) clay, light gray (10YR 7/2) moist; moderate, medium and thin, platy structure; hard, firm, very sticky and plastic; few reddish brown stains; neutral; clear, smooth boundary. 4 to 5 inches thick.

IIIB'21-59 to 63 inches, light-gray (10YR 7/1) fine sand, gray (10YR 5/1) moist; single grained; very hard, very firm, nonsticky and nonplastic; many, wavy, 1/16 to 3/4 of an inch bands of sandy clay loam, pale brown (10YR 6/3) and yellowish red (5YR 5/8) dry, brown (10YR 5/3) and yellowish red (5YR 4/6) moist; bands are slightly sticky and slightly plastic and have blocky structure; bands more than 1 centimeter thick total 3 centimeters of horizon; neutral; clear, wavy boundary. 3 to 6 inches thick.

IIIB'22-63 to 89 inches, light-gray (10YR 7/1) fine sand, gray (10YR 5/1) moist; single grained; slightly hard, firm, nonsticky and nonplastic; strong-brown (7.5YR 5/6) bands of sandy clay loam, dark brown (7.5YR 4/4) moist; bands more than 1 centimeter thick total more than 2 centimeters in upper 17 inches of horizon; strong, medium, platy structure; slightly sticky and slightly plastic; neutral; clear, wavy boundary.

The content of coarse fragments between depths of 10 to 40 inches is less than 10 percent by weighted average. In places stratified sand or loamy fine sand occurs below a depth of 4 feet.

PaC-Pausant fine sandy loam, 0 to 15 percent slopes. This is a nearly level to strongly sloping soil on terraces. It has the profile described as representative of the series. Small areas of Karamin soils are included in mapping. Runoff is slow or medium, and the erosion hazard is slight to severe. This soil is used for woodland, wildlife, and grazing. Capability subclass IVe nonirrigated ; woodland subclass 3o.

PaE-Pausant fine sandy loam, 15 to 35 percent slopes. This is a moderately steep to steep soil on terraces and at terrace edges. Runoff is medium or rapid, and the erosion hazard is moderate or severe. This soil is used for woodland, wildlife, and grazing. Capability subclass IVe nonirrigated; woodland subclass 4o.

PaF-Pausant fine sandy loam, 35 to 65 percent slopes. This is a steep to very steep soil at terrace edges. Runoff is rapid or very rapid, and the erosion hazard is very severe. This soil is used for woodland, wildlife, and grazing. Capability subclass VIe nonirrigated; woodland subclass 4r.

Peat and Muck

Pk-Peat and Muck are very poorly drained soils formed in decomposed or partly decomposed plant remains. These soils occupy depressions or basins in the flood plains of perennial and intermittent streams throughout the survey area. The vegetation is mainly sedges, rushes, and tules, and scattered deciduous shrubs. Elevations range from 2,100 to 3,500 feet. The annual precipitation is 14 to 19 inches, the mean annual air temperature is 43° F, and the frost-free period is about 100 days. Associated with these soils are areas of Ret soils and Marsh.

Most mapped areas are about 5 acres in size. The largest, about 15 acres, is along Golden Harvest Creek, southwest of Republic.

In an area adjacent to Ward Lake, the peat extends to a depth of about 20 inches. It is underlain by about 16 inches of white marl, which is strongly alkaline and calcareous. Below this to a depth of more than 50 inches is fine and coarse sand.

In the area along Golden Harvest Creek, the muck extends to a depth of more than 82 inches. It is black when moist and is slightly acid. Except for the upper 5 inches, it contains lenses of light-gray volcanic ash.

Peat and Muck soils are moderately permeable. Because they lack drainage outlets, they are ponded for most of the year.

These soils provide excellent habitat for ducks, mink, beaver, and muskrat. They are not suitable for cultivation unless drained. Capability unit Vw-1 nonirrigated ; not assigned to a range site or woodland subclass.

Pepoon Series

The Pepoon series consists of well-drained, moderately steep to steep soils underlain by fractured quartzite bedrock at a depth of 8 to 15 inches. These soils formed in a mixture of volcanic ash, coarse granitic fragments, and glacial till. They are on mountainsides, ridges, knolls, and peaks and in saddles at elevations of 2,500 to 5,000 feet. The vegetation is

mainly ponderosa pine, Douglas-fir, bluebunch wheatgrass, Sandberg bluegrass, and eriogonum. The annual precipitation is 18 to 35 inches. The mean annual air temperature is 42° to 45° F. The frost-free period is 90 to 110 days. Pepoon soils are associated with Vallan, Molson, Nevine, and Tenas soils.

In a representative profile, the upper 5 inches is very dark gray extremely stony loam and the lower 5 inches is very dark brown extremely stony loam. Below this is bedrock. Many large stones and cobbles are on the surface and throughout the soil.

Permeability is moderate, and available water capacity is very low. Roots penetrate to bedrock.

Pepoon soils are used for woodland, wildlife, and grazing.

Representative profile of Pepoon extremely stony loam, 15 to 35 percent slopes, under shrubby plant cover in clearing north of Mattson Creek along Davis Lake logging road, NE1/4NE1/4NW1/4 sec. 2, T. 37 N., R. 36 E., Colville National Forest:

A11-0 to 5 inches, very dark gray (10YR 3/1) extremely stony loam, black (10YR 2/1) moist; single grained; loose, friable, nonsticky and nonplastic; many fine roots; 25 percent stones; slightly acid; clear, wavy boundary. 4 to 6 inches thick.

A12-5 to 10 inches, very dark brown (10YR 2/2) extremely stony loam, black (10YR 2/1) moist; single grained; loose, very friable, nonsticky and nonplastic; many fine roots; 60 percent stones; mildly alkaline; abrupt, smooth boundary. 4 to 9 inches thick.

IIR-10 inches, fractured quartzitic bedrock.

The mean annual soil temperature at a depth of 8 to 15 inches ranges from 42° to 45° F. The soil is more than 60 percent volcanic ash in the fine earth fraction and 35 to 50 percent coarse fragments that are dominantly stone size. Depth to bedrock ranges from 8 to 15 inches. The A1 horizon is extremely stony loam or silt loam that is massive or single grained or has weak, blocky structure. The IIR horizon is fractured, but cracks are more than 4 inches apart.

PnE-Pepoon extremely stony loam, 15 to 35 percent slopes. This moderately steep to steep soil is on mountain ridges and slopes. It has the profile described as representative of the series. A few small areas where the slope is 35 to 45 percent are included in mapping. Runoff is medium, and the erosion hazard is moderate. The entire acreage provides grazing and wildlife habitat. Capability subclass VIIs nonirrigated; woodland subclass 5x; Shallow range site.

PoE-Pepoon-Edds complex, 15 to 50 percent slopes.

This moderately steep to very steep mapping unit is on mountainsides. It is 40 to 70 percent Pepoon soil and 30 to 60 percent Edds soil. The Edds soil is described under the heading Edds Series. Small areas of Cobey, Koepke, Toroda, and Growden soils are included in mapping. Runoff is medium to very rapid, and the erosion hazard is moderate to very severe. All the acreage provides grazing and wildlife habitat. Capability subclass VIIs nonirrigated; Shallow range site; woodland subclass 5x for Pepoon soil, 3r for Edds soil.

PpE-Pepoon-Oxerine complex, 15 to 50 percent slopes. This moderately steep to very steep mapping unit is in mountainous areas and at terrace edges. It is 40 to 70 percent Pepoon soil and 30 to 60 percent Oxerine soil. The Oxerine soil is described under the heading Oxerine Series. Runoff is medium to very rapid, and the hazard of erosion is moderate to very severe. The entire acreage provides grazing and wildlife habitat. Capability subclass VIIs nonirrigated; Shallow range site; woodland subclass 5x for Pepoon soil, 3d for Oxerine soil.

PrE-Pepoon-Rock land complex, 15 to 50 percentslopes. This moderately steep to very steep mapping unit is in mountainous areas. It is 40 to 70 percent Pepoon soil and 30 to 60 percent Rock land. Rock land is 50 to 90 percent rock outcrop and 10 to 50 percent very shallow soils. Runoff is medium to very rapid, and the erosion hazard is moderate to very severe. All the acreage provides grazing and wildlife habitat. Capability unit VIIs-1 nonirrigated; Shallow range site; woodland subclass 5x for Pepoon soil, 5x for Rock land.

PtE-Pepoon-Togo loams, 15 to 50 percent slopes. This moderately steep to very steep mapping unit is in mountainous areas. It is 40 to 70 percent Pepoon soil and 30 to 60 percent Togo soil. The Togo soil is described under the heading Togo Series. Runoff is medium to very rapid, and the erosion hazard is moderate to very severe. The entire acreage provides grazing and wildlife habitat. Capability subclass VIIs nonirrigated; Shallow range site; woodland subclass 5x for Pepoon soil, 3r for Togo soil.

Republic Series

The Republic series consists of well-drained, nearly level to steep soils formed in volcanic ash and alluvium derived from glacial till. These soils are on alluvial fans and uplands at elevations of 1,900 to 3,500 feet. The vegetation is mainly bluebunch wheatgrass, snowberry, and ponderosa pine. The annual precipitation is 14 to 20 inches. The mean annual air temperature is about 43° F. The frost-free period is 100 to 130 days. Republic soils are associated with Chesaw, Hunters, Mires, and Molson soils.

In a representative profile, the upper 6 inches is darkgray loam. It is underlain by 11 inches of grayishbrown sandy loam. Below this is gravelly sandy loam that is brown in the upper 7 inches, pale brown in the next 15 inches, and light grayish brown and slightly effervescent in the lower 21 inches.

Permeability is moderate. Available water capacity is low to high. Roots penetrate to a depth of 60 inches or more.

Republic soils are used chiefly for alfalfa, grass, small grain, and grazing. A small acreage is wooded. Only a small acreage is irrigated.

Representative profile of Republic loam, 0 to 8 percent slopes, in a cultivated area 900 feet east and 350 feet south of the northwest corner of sec. 2, T. 39 N., R. 32 E.

Ap-0 to 6 inches dark-gray (10YR 4/1) loam, black (10YR 2/1) moist; weak, fine, granular structure; soft, very-friable, slightly plastic and nonsticky; common roots; 10 percent gravel; slightly acid; abrupt, smooth boundary. 5 to 7 inches thick.

A12-6 to 17 inches, grayish-brown (10YR 5/2) sandy loam, very dark brown (10YR 2/2) moist; weak, medium, granular structure; soft, very friable, nonplastic and nonsticky; common roots; few fine pores; 10 percent gravel; neutral; clear, smooth boundary. 5 to 13 inches thick.

IIB2-17 to 24 inches, brown (10YR 5/3) gravelly sandy loam, dark brown (10YR 3/3) moist; weak, fine,

subangular blocky structure; soft, very friable, nonplastic and nonsticky; common roots; few fine pores; 25 percent gravel; neutral; clear, smooth boundary. 4 to 10 inches thick.

IIC1-24 to 39 inches, pale-brown (10YR 6/3) gravelly sandy loam, dark grayish brown (10YR 4/2) moist; massive; soft, very friable, nonplastic and nonsticky; common roots; few fine pores; 25 percent gravel, some cobbles and stones; neutral; gradual, smooth boundary. 10 to 20 inches thick.

IIC2-39 to 60 inches, light grayish-brown (2.5Y 6/2) gravelly sandy loam, dark grayish brown (2.5Y 4/2) moist; massive; soft, very friable, nonplastic and nonsticky; few roots; 30 percent gravel, some cobbles and stones; gravel coated on undersides with calcium carbonate; slightly effervescent; mildly alkaline.

Between depths of 20 to 40 inches, the soil ranges from 5 to 35 percent coarse fragments and is less than 18 percent clay and more than 15 percent particles coarser than very fine sand. The A horizon is 10 to 20 inches thick. The C horizon ranges from neutral to moderately alkaline and in places is calcareous in the lower part.

RcB-Republic fine sandy loam, 0 to 8 percent slopes. This is a nearly level to gently sloping soil on terraces and alluvial fans. It has a profile similar to the one described as representative of the series, but the surface layer differs in texture and the subsoil is sandy loam. Runoff is very slow or slow, and the erosion hazard is slight. Available water capacity is low to moderately high. This soil is used for irrigated alfalfa, grass, and small grain. It also provides grazing. Capability unit IIIe-1 nonirrigated, IIIe-1 irrigated; Loamy range site.

ReB-Republic loam, 0 to 8 percent slopes. This is a nearly level to gently sloping soil on alluvial fans and terraces. It has the profile described as representative of the series. Runoff is very slow or slow, and the erosion hazard is slight. Available water capacity is moderate to high. This soil is used for alfalfa (fig. 6), grass, small grain, and grazing. Cultivated crops are irrigated where water is available. Capability unit IIIe-1 nonirrigated, IIIe-1 irrigated; Loamy range site.

ReC-Republic loam, 8 to 15 percent slopes. This is a strongly sloping soil on old alluvial fans. Runoff is medium, and the erosion hazard is moderate. Available water capacity is low to moderately high. This soil is used for small grain, alfalfa, grass, and grazing. A small acreage is irrigated. Capability unit IIIe-1 nonirrigated, IIIe-1 irrigated; Loamy range site.

ReE-Republic loam, 15 to 35 percent slopes. This is a moderately steep to steep soil on uplands. A few small areas of Mires soil are included in mapping. Runoff is medium or rapid, and the erosion hazard is moderate or severe. Available water capacity is low to moderately high. The entire acreage is used for grazing. Capability unit VIe-1 nonirrigated; Loamy range site.

RgC-Republic gravelly loam, 0 to 15 percent slopes. This is a nearly level to strongly sloping soil on uplands. It has a profile similar to the one described as representative of the series, but the surface layer is about 20 percent gravel. Included in mapping are

Figure 6.-Irrigated alfalfa in an area of Republic loam, 0 to 8 percent slopes. Mires soils are on the terraces. Molson and Vallan soils are on mountainsides in the background.

small areas where the surface layer is gravelly sandy loam or is more than 50 percent gravel. Also included are areas of Mires gravelly loam, which make up about 10 percent of this unit. Runoff is very slow to medium, and the erosion hazard is slight or moderate. Available water capacity is low to moderately high. This soil is used mainly for irrigated alfalfa, grass, and small grain. Capability unit IIIe-1 nonirrigated, IIIe-1 irrigated; Loamy range site.

Resner Series

The Resner series consists of well-drained, nearly level to very steep soils formed in volcanic ash over glacial outwash. These soils are on terraces at elevations of 4,000 to 6,000 feet. The vegetation is mainly Douglas-fir, larch, subalpine fir, pachistima, and snowberry. The annual precipitation is 25 to 40 inches. The mean annual air temperature is about 38° F. The frost-free period is 70 to 100 days. Resner soils are associated with Scar, Togo, and Manley soils.

In a representative profile, a mat of undecomposed needles, leaves, and twigs is at the surface. Below this is 1 inch of light-gray loam and 19 inches of pinkishgray loam. The underlying material to a depth of 60 inches or more is light-gray gravelly loamy sand.

Permeability is moderate to a depth of 20 inches and rapid below. Available water capacity is low or moderate. Roots penetrate to a depth of 60 inches or more.

Resner soils are used for woodland, wildlife, and grazing.

Representative profile of Resner loam, 0 to 15 percent slopes, in a forested area, NW1/4SE1/4 sec. 8, T. 36 NT., R. 35 E., at gravel pit on Albion Hill Road north from Sherman Pass Highway:

O1-1 inch to 0, undecomposed mat of leaves, twigs, and needles.

A2-0 to 1 inch, light-gray (10YR 7/1) loam, dark yellowish brown (10YR 3/4) moist; single grained; loose, friable, nonsticky and nonplastic; strongly acid; abrupt, wavy boundary. 1/4 inch to 2 inches thick.

B2ir-1 inch to 20 inches, pinkish-gray (7.5YR 7/1) loam, dark brown (7.5YR 4/4) moist; weak, medium, granular and weak, medium, subangular blocky structure; soft, friable, nonsticky and nonplastic; many fine roots; slightly acid; abrupt, irregular boundary. 18 to 25 inches thick.

IIC-20 to 60 inches, light-gray (10YR 7/2) gravelly loamy sand, dark grayish brown (10YR 4/2) moist; single rained; loose, nonsticky and nonplastic; few 1/2 to 3/4 of an inch iron bands in upper part of horizon; 45 percent gravel; medium acid.

The upper 20 inches is dominantly volcanic ash. Below a depth of 20 inches, the content of coarse fragments is 35 to 50 percent. The A2 horizon is loam or silt loam. The Bir horizon is loam or silt loam. It has weak granular structure or weak blocky structure or is single grained. The IIC hori zon is gravelly sand or gravelly loamy fine sand.

RnC-Resner loam, 0 to 15 percent slopes. This nearly level to strongly sloping soil is on terraces. It has the profile described as representative of the series. A few small areas where the slope is 15 to 25 percent are included in mapping. Runoff is very slow to medium, and the erosion hazard is slight to moderate. This soil is used for woodland, wildlife, and grazing. Capability subclass IVe nonirrigated; woodland subclass 3o.

RnF-Resner loam, 35 to 65 percent slopes. This steep to very steep soil is at terrace edges. Runoff is rapid or very rapid, and the erosion hazard is severe or very severe. This soil is used for woodland, wildlife, and grazing. Capability subclass VIe nonirrigated; woodland subclass 4r.

Ret Series

The Ret series consists of somewhat poorly drained, nearly level soils formed in mixed alluvium derived from volcanic ash and micaceous, acid igneous rock. These soils are in depressions and on bottom land along perennial streams at elevations of 1,700 to 3,000 feet. The vegetation is aspen, cottonwood, willows, and water-tolerant grasses. The annual rainfall is 14 to 19 inches. The mean annual air temperature is about 43° F. The frost-free period is 90 to 120 days. Ret soils are associated with the Hodgson soils and Peat and Muck.

In a representative profile, the uppermost 29 inches is silt loam. It is dark gray in the upper 7 inches, dark grayish brown in the next 7 inches, and grayish brown in the lower 15 inches. Below this is a 1-inch layer of white pumicite over 15 inches of light brownish-gray and light-gray loam. This loam is underlain to a depth of 60 inches or more by multicolored sand.

Permeability is moderate. Available water capacity is high. Roots penetrate to a depth of 45 inches or more.

Ret soils are used for hay, pasture, small grain, and wildlife.

Representative profile of Ret silt loam in hay meadow 1,100 feet north and 200 feet west of the southeast corner of sec. 30, T. 39 N., R. 33 E., Lundimo Meadows:

Ap-0 to 7 inches, dark-gray (10YR 4/1) silt loam, black (10YR 2/1) moist; moderate, medium, granular structure; slightly hard, friable, slightly sticky and slightly plastic; many roots; neutral; clear, smooth boundary. 5 to 10 inches thick.

A1-7 to 14 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak, coarse, subangular blocky structure; slightly hard, friable, sticky and slightly plastic; many roots; many fine and very fine pores; neutral; clear, smooth boundary. 3 to 8 inches thick.

AC-14 to 29 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak, medium and coarse, prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; common roots; many fine and medium pores; neutral; abrupt, smooth boundary. 10 to 18 inches thick.

IIC1-29 to 30 inches, white (10YR 8/2) silt loam pumicite, grayish brown (10YR 5/2) moist; massive; soft, very friable, nonsticky and nonplastic; few roots; common medium pores; neutral; abrupt, smooth boundary. 0 to 5 inches thick.

IIIC2-30 to 37 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; massive; hard firm, sticky and plastic; few roots; common medium pores; common, medium, faint, dark yellowish-brown (10YR 4/4) mottles; neutral; clear, wavy boundary. 3 to 9 inches thick.

IIIC3-37 to 45 inches, light gray (2.5Y 7/2) loam, grayish brown (2.5Y 5/2) moist; massive; hard, friable, slightly sticky and slightly plastic; few roots; common, medium, distinct, yellowish brown (10YR 5/4) mottles; neutral; clear, wavy boundary. 5 to 20 inches thick.

IVC4-45 to 60 inches, multicolored sand; single grained; 10 to 15 percent loose gravel; neutral.

Reaction ranges from neutral to medium acid. Between depths of 10 to 40 inches, the soil by weighted average is

less than 18 percent clay and less than 15 percent material coarser than very fine sand. The A1 and AC horizons are silt loam, loam, or very fine sandy loam.

Rs-Ret silt loam. This is a nearly level soil on bottom land. It has the profile described as representative of the series. About 6 percent of the total acreage of this mapping unit is included areas of the Ret variant and 15 percent areas where layers of sand or gravelly sand are at a depth of 15 to 30 inches. Runoff is very slow, and the erosion hazard is slight. The water table is at a depth of 1 foot to 4 feet, depending on the level of the streams. This soil is used for grasses and legumes (fig. 7) and for wildlife. Capability unit IVw-1 nonirrigated; not assigned to a range site or a woodland subclass.

Ret Variant

This variant of the Ret series consists of nearly level, poorly drained soils formed in alluvium. These soils are on bottom land at elevations of 1,800 to 2,900 feet. The vegetation is mainly western redcedar, pachistima, and ladyfern. The annual precipitation is 14 to 18 inches. The mean annual air temperature is about 43° F. The frost-free period is 90 to 120 days. The Ret variant is associated with Tonata and Shaskit soils.

In a representative profile, the uppermost 4 inches is dark-gray silt loam. Next is 30 inches of silty clay loam. The top 14 inches is dark gray, and the bottom 16 inches is grayish brown. Below this is 9 inches of light brownish-gray silt loam. It is underlain to a depth of 60 inches or more by light brownish-gray silty clay.

Permeability is slow. Available water capacity is high. Roots penetrate to a depth of 60 inches or more.

The Ret variant is used for woodland, wildlife, and grazing.

Representative profile of Ret silt loam, heavy variant, in an area along the San Poil River, 500 feet south and 100 feet east of the northeast corner of SW1/4 sec. 30, T. 36 N., R. 36 E.

A11-0 to 4 inches, dark-gray (10YR 4/1) silt loam, black (10YR 2/1) moist; moderate, fine, granular structure; hard, friable, slightly plastic and sticky; many roots; neutral; clear, smooth boundary. 4 to 10 inches thick.

A12-4 to 12 inches, dark-gray (10YR 4/1) silty clay loam, black (10YR 2/1) moist; moderate, medium and coarse, granular structure; hard, firm, plastic and sticky; many roots; neutral; clear, smooth boundary. 5 to 10 inches thick.

A13-12 to 18 inches, dark-gray (10YR 4/1) silty clay loam, black (10YR 2/1) moist; few, fine, faint, dark brown (7.5YR 3/4) mottles; weak, coarse, subangular blocky structure; very hard, firm, plastic

Figure 7.-An area of Ret silt loam cleared for pasture and used for grazing.

and sticky; many roots; many fine and very fine pores; neutral; clear, smooth boundary. 4 to 8 inches thick.

B2g-18 to 25 inches, grayish-brown (2.5Y 5/2) silty clay loam, very dark grayish brown (2.5Y 3/2) moist; many, large, distinct, dark-brown (7.5YR 3/4) mottles; moderate, medium, subangular blocky structure; very hard, firm, plastic and sticky; many roots; many fine and medium pores; neutral; clear, smooth boundary. 5 to 10 inches thick.

C1-25 to 34 inches, grayish-brown (2.5Y 5/2) silty clay loam, very dark grayish brown (2.5Y 3/2) moist; common, medium, distinct, brown (10YR 4/3) mottles; massive; very hard, firm, plastic and sticky; many roots; many fine and medium pores; neutral; clear, smooth boundary. 5 to 15 inches thick.

C2-34 to 43 inches, light brownish-gray (2.5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) moist; few, medium, distinct, brown (10YR 4/3) mottles; massive; hard, friable, slightly plastic and slightly sticky; few roots; common medium pores; neutral; clear, smooth boundary. 4 to 20 inches thick.

C3-43 to 60 inches, light brownish-gray (2.5Y 6/2) silty clay, dark grayish brown (2.5Y 4/2) moist; massive; very hard, firm, plastic and sticky; few roots; few medium pores; neutral.

Reaction is neutral or mildly alkaline. The content of coarse fragments ranges from 0 to 10 percent. The 10- to 40inch section is 18 to 35 percent clay and less than 15 percent particles coarser than very fine sand. The soil is mottled within 20 inches of the surface. In places the C horizon contains lenses of fine sandy loam and pumice less than 3 inches thick.

Rt-Ret silt loam, heavy variant. This is a nearly level soil on bottom land. It has the profile described as representative of the variant. Runoff is very slow, and the erosion hazard is slight. The water table is at a depth of 1 foot to 4 feet, depending on the level of the streams. This soil is used mainly as wildlife habitat. When drained, it is used for grasses, legumes, hay, and pasture. Capability unit IVw-1 nonirrigated; not assigned to a range site or woodland subclass.

Riverwash

Rv-Riverwash consists of nearly level bars of recently deposited coarse sand and gravel alluvium. It occurs along perennial and intermittent streams and is flooded every year by runoff from melting snow. It has a very sparse plant cover of brush and deciduous trees. It is used mainly as wildlife habitat. In an area near Curlew, it is mined and used as construction material. Capability unit VIIIw-1 nonirrigated; not assigned to a range site or woodland subclass.

Rock Land

Rw-Rock land ranges over a wide area throughout the uplands. It is 50 to 90 percent rock outcrop and 10 to 50 percent very shallow, very stony soils. In many areas the rock outcrop is broken by steep, narrow drainage channels or draws 25 to 200 feet deep. These areas provide protection, food, and water for wildlife. The vegetation is moss and lichens on the bedrock and scattered scrubby ponderosa pine, Douglas-fir, Oregongrape, snowberry, ninebark, and bluebunch wheatgrass on the very shallow soils. Rock land is used for wildlife and water supply. Capability unit VIIIs-1 nonirrigated; woodland subclass 5x.

Scala Series

The Scala series consists of well-drained, nearly level to steep soils formed in sandy outwash derived from acid igneous rocks, mainly granite, and from volcanic ash and loess. These soils are on terraces and terrace slopes at elevations of 1,500 to 2,000 feet. The vegetation is mainly ponderosa pine, Douglas-fir, Oregongrape, and pinegrass. The annual precipitation is 17 to 20 inches. The mean annual air temperature is about 46° F. The frost-free period is 110 to 130 days. Scala soils are associated with the Bisbee, Cedonia, Dart, and Hodgson soils.

In a representative profile, a very thin mat of needles, leaves, twigs, and bark at the surface overlies a 1/4-inch layer of grayish-brown loamy fine sand. Next is about 48 inches of fine sandy loam that is brown in the upper 113/x, inches, pale brown in the next 10 inches, and light yellowish brown in the lower 26 inches. Below this to a depth of 60 inches or more is pale-olive silt loam.

Permeability is moderate. Available water capacity is high. Roots penetrate to a depth of 60 inches or more.

Scala soils are used for irrigated hay and small grain. They are also used as woodland and homesites.

Representative profile of Scala fine sandy loam, 0 to 8 percent slopes, in a forested area 1,980 feet west and 1,930 feet south of the northeast corner of sec. 32, T. 37 N., R. 37 E.

O1-1/2 inch to 0, undecomposed mat of needles, leaves, twigs, and bark.

A2-0 to 1/4 inch, grayish-brown (10YR 5/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; single grained; slightly acid; abrupt, broken boundary. 0 to 1/2 inch thick.

B21-1/4 inch to 4 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/4) moist; weak, fine, subangular blocky structure; soft, very friable, nonsticky and slightly plastic; many fine roots; slightly acid; clear, smooth boundary. 3 to 4 inches thick.

B22-4 to 12 inches, brown (10YR 5/3) fine sandy loam, dark yellowish brown (10YR 3/4) moist; weak, fine and medium, subangular blocky structure; soft, very friable, nonsticky and slightly plastic; many fine, medium, and coarse roots; slightly acid; gradual, wavy boundary. 6 to 14 inches thick.

B23-12 to 22 inches, pale-brown (10YR 6/3) fine sandy loam, brown or dark brown (10YR 4/3) moist; weak, fine and medium, subangular blocky structure; soft, very friable, nonsticky and slightly plastic; fine, medium, and coarse roots; common very fine pores; slightly acid; clear, wavy boundary. 9 to 12 inches thick.

C1-22 to 35 inches, light yellowish-brown (10YR 6/4) fine sandy loam, dark yellowish brown (10YR 4/4) moist; few, fine, faint, yellowish-brown (10YR 5/6) stains ; massive ; slightly hard, very friable, nonsticky and slightly plastic; common fine and few coarse roots; common very fine pores; one distinct wavy band; slightly acid; gradual, wavy boundary. 8 to 14 inches thick.

C2-35 to 48 inches, light yellowish-brown (10YR 6/4) fine sandy loam, dark yellowish brown (10YR 4/4) moist; massive; slightly hard, friable, nonsticky and slightly plastic; common fine and few medium and coarse roots; common very fine pores; several distinct brown (7.5YR 5/4) wavy bands; neutral; abrupt, smooth boundary. 8 to 14 inches thick.

IIB'21-48 to 59 inches, pale-olive (5Y 6/3) silt loam, olive brown (2.5Y 4/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few

very fine and fine roots; common very fine pores; neutral; abrupt, smooth boundary. 0 to 12 inches thick.

IIB'22t-59 to 60 inches, pale-olive (5Y 6/3) heavy silt loam, olive brown (2.5Y 4/4) moist; massive; hard, firm, sticky and plastic; very few very fine and fine roots; many very fine pores; moderately thick clay films in very fine pores; neutral.

Reaction ranges from neutral to medium acid. The 10to 40-inch section is less than 18 percent clay and more than 15 percent particles coarser than very fine sand. The content of coarse fragments is less than 10 percent. In places the soil has a thin A1 horizon. The A2 horizon is loamy fine sand or fine sandy loam. The B horizon is fine sandy loam or sandy loam. The C horizon is sandy loam or fine sandy loam in which clay and iron have accumulated in bands and stains. In places a IIB'2 horizon of massive silt loam or silty clay loam is at a depth of 40 inches or more.

ScB-Scala fine sandy loam, 0 to 8 percent slopes. This nearly level to gently sloping soil is on terraces. It has the profile described as representative of the series. Included in mapping are small areas where bedrock is at a depth of 3 to 4 feet. About 15 percent of this unit is included areas where gravelly loamy sand is at a depth of 30 to 36 inches, and 5 percent is areas of Bisbee soil. Runoff is very slow or slow, and the hazard of erosion is slight. This soil is used for irrigated alfalfa and grass for hay and pasture. It is also used as woodland and homesites. Capability unit IIIe-2 nonirrigated, IIIe-3 irrigated; woodland subclass 3o.

ScC-Scala fine sandy loam, 8 to 15 percent slopes. This strongly sloping soil is on terraces. Included in mapping are areas of a steep Scala soil, which make up about 25 percent of this unit. Runoff is medium, and the erosion hazard is moderate. This soil is used as woodland and wildlife habitat. Only a small area is cultivated. Capability unit IIIe-2 nonirrigated; woodland subclass 3o.

ScE-Scala fine sandy loam, 25 to 45 percent slopes. This steep soil is on uplands. Runoff is rapid, and the erosion hazard is severe. This soil is used as woodland. Capability unit VIe-3 nonirrigated; woodland subclass 3r.

Scar Series

The Scar series consists of well-drained, nearly level to very steep soils formed in glacial till. These soils are on mountainous uplands at elevations of 4,000 to 6,500 feet. The vegetation is mainly subalpine fir, Douglas-fir, western larch, and dwarf huckleberry. The annual precipitation is 35 to 40 inches. The mean annual air temperature is about 38° F. The frost-free period is 70 to 90 days. Scar soils are associated with Manley and Togo soils.

In a representative profile, a 2-inch mat of organic material is at the surface. Next, in sequence downward, is 1 inch of gray very fine sandy loam, 6 inches of strong-brown sandy loam, and 12 inches of strongbrown loamy fine sand and light-gray loamy sand. Below this to a depth of 60 inches is light-gray sandy loam.

Permeability is rapid. Available water capacity is low to moderately high. Roots penetrate to a depth of 60 inches or more.

Scar soils are used for woodland, wildlife, and grazing.

Representative profile of Scar sandy loam, 0 to 15 percent slopes, in a second-growth forest, NE1/4SE1/4 sec. 23, T. 36 N., R. 34 E., 50 yards south upslope from Sherman Pass Highway, 18 miles southeast of Republic:

O1-2 inches to 1 inch, leaves, twigs, and needles.

O2-1 inch to 0, partly decomposed leaves, twigs, and needles; abrupt, wavy boundary. 1/2 inch to 1 1/2 inches thick.

A2-0 to 1 inch, gray (10YR 6/1) very fine sandy loam, gray (10YR 5/1) moist; massive; slightly hard, firm, nonsticky and nonplastic; very strongly acid; abrupt, smooth boundary. 1/a inch to 1 1/2 inches thick.

B21ir-1 inch to 7 inches, strong-brown (7.5YR 5/6) sandy loam, dark brown (10YR 4/4) moist; weak, medium, subangular blocky structure; soft, friable, slightly sticky and nonplastic; many fine roots; medium acid; abrupt, irregular boundary. 3 to 16 inches thick.

B22ir-7 to 10 inches, strong-brown (7.5YR 5/6) loamy fine sand, dark brown (7.5YR 4/2) moist; massive; slightly hard, slightly firm, nonsticky and nonplastic; many fine roots; medium acid; abrupt, irregular boundary. 3 to 16 inches thick.

A'2-10 to 19 inches, light-gray (N/7/) loamy sand, gray (5Y 5/1) moist and streaks of dark brown (7.5YR 4/4) moist; massive; slightly hard, slightly firm, nonsticky and nonplastic; few large roots; vesicular; medium acid; clear, wavy boundary. 0 to 34 inches thick.

IIB'2-19 to 60 inches, light-gray (5Y 7/2) sandy loam, olive gray (5YR 5/2) moist; massive; hard, firm, sticky and slightly plastic; few large roots; sand grains bridged with clay; medium acid.

The content of coarse fragments in the 10- to 40-inch section by volume ranges from 5 to 35 percent. Reaction ranges from slightly acid to very strongly acid. The A2 horizon is very fine sandy loam, sandy loam, or loamy fine sand. The Bir horizon ranges from sandy loam to loamy coarse sand, is gravelly in places, and is single grained, massive, or has weak subangular blocky structure. The A'2 horizon ranges from fine sandy loam to loamy coarse sand and in places is gravelly. The IIB'2 horizon, where it occurs, ranges from loamy sand to sandy clay and in places is gravelly. In places horizons that are more than 18 percent clay are below a depth of 40 inches. In places there is a IIC horizon that is similar in color and texture to the IIB'2 horizon.

SdC-Scar sandy loam, 0 to 15 percent slopes. This is a nearly level to strongly sloping soil in basins. It has the profile described as representative of the series. Runoff is slow or medium, and the erosion hazard is slight or moderate. This soil is used as woodland and wildlife habitat. It also provides limited grazing. Capability subclass IVe nonirrigated; woodland subclass 3o.

SdE-Scar sandy loam, 15 to 35 percent slopes. This is a moderately steep to steep soil on mountainsides. A few small areas where the slope is 30 to 45 percent are included in mapping. Runoff is medium or rapid, and the erosion hazard is moderate or severe. This soil is used as woodland and wildlife habitat. It also provides limited grazing. Capability subclass IVe nonirrigated; woodland subclass 3o.

SdF-Scar sandy loam, 35 to 65 percent slopes. This is a steep to very steep soil on mountainsides and at terrace edges. Runoff is rapid or very rapid, and the erosion hazard is severe or very severe. This soil is used mainly as woodland and wildlife habitat. Capability subclass VIe nonirrigated ; woodland subclass 4r.

Shaskit Series

The Shaskit series consists of somewhat poorly drained, nearly level soils formed in glacial outwash and alluvium. These soils are on bottom land at elevations of 2,500 to 5,500 feet. The vegetation is mainly Douglas-fir, western redcedar, and grand fir. The annual rainfall is 25 to 40 inches. The mean annual air temperature is 42° to 45° F. The frost-free period is 70 to 100 days. Shaskit soils are associated with Goddard, Tonata, and Torboy soils.

In a representative profile, the upper 7 inches is pinkish-gray silt loam. Next, in sequence downward, is 10 inches of very pale brown sandy loam, 7 inches of very pale brown coarse sand, and 20 inches of pink loam, brown clay loam, and brown sandy clay loam. Below this to a depth of 60 inches or more is lightbrown loamy coarse sand.

Permeability is moderately slow. Available water capacity is high or moderately high. Root penetration is very deep. Depth to the seasonal high water table ranges from 24 to 48 inches.

Shaskit soils are used for woodland, wildlife, and grazing.

Representative profile of Shaskit silt loam in a forested area of the Shaskit-Tonata complex, NE1/4 SE1/4 sec. 29, T. 37 N., R. 36 E., adjacent to forest road on south side of South Fork Deadman Creek, 100 yards east of steel guard:

A1-0 to 7 inches, pinkish-gray (7.5YR 7/2) silt loam, dark brown, (7.5YR 3/2) moist; moderate, medium and coarse, angular blocky and fine granular structure; slightly hard; friable, slightly sticky and slightly plastic; many fine roots; neutral; clear, wavy boundary. 6 to 8 inches thick.

AC-7 to 17 inches, very pale brown (10YR 7/3) sandy loam, brown (10YR 5/3) moist; massive; soft, friable, nonsticky and nonplastic; common fine roots ; neutral ; clear, wavy boundary. 9 to 11 inches thick.

IIC1-17 to 24 inches, very pale brown (10YR 7/3) coarse sand, brown (10YR 5/3) moist; massive; hard, slightly firm, slightly sticky and nonplastic; few medium and fine roots; few brittle, brown (7.5YR 4/4), iron-stained mottles; neutral; clear, wavy boundary. 6 to 9 inches thick.

IIIC2-24 to 31 inches, pink (7.5YR 7/4) loam, brown (7.5YR 4/4) moist; massive; hard, firm, slightly sticky and slightly plastic; few roots; neutral; clear, wavy boundary. 6 to 9 inches thick.

IVC3-31 to 36 inches, brown (7.5YR 5/4) clay loam, brown (7.5YR 4/4) moist; strong, medium and coarse, angular blocky structure; hard, firm, sticky and plastic; neutral; clear, wavy boundary. 4 to 7 inches thick.

IVC4-36 to 44 inches, brown (7.5YR 5/4) sandy clay loam, brown (7.5YR 4/4) moist; massive; hard, firm, sticky and plastic; few medium and large roots; neutral; clear, wavy boundary. 7 to 10 inches thick.

VC5-44 to 60 inches, light-brown (7.5YR 6/4) loamy coarse sand, brown (7.5YR 4/4) moist; massive; hard, firm, slightly sticky and slightly plastic; few large roots; strong-brown (7.5YR 5/6) stains; some sand grains bridged with clay; neutral.

The A horizon is 30 to 60 percent volcanic ash and has a bulk density of less than 0.95. Reaction ranges from slightly acid to neutral. Between depths of 10 to 40 inches, the soil is less than 18 percent clay and more than 15 percent particles coarser than very fine sand. The Al horizon ranges from silt loam to sandy loam and has weak or moderate blocky or granular structure. The AC horizon ranges from sandy loam to sand. The C horizon is highly stratified and ranges from coarse sand to clay loam.

Sh-Shaskit-Tonata complex. This nearly level mapping unit is on bottom land. It is 40 to 70 percent Shaskit silt loam and 30 to 60 percent Tonata silt loam. The Shaskit and Tonata soils have the profiles described as representative of their respective series. Included in mapping are a few small areas of Marsh and peat. Runoff is very slow, and the erosion hazard is slight. This mapping unit is used as woodland and wildlife habitat. It also provides limited grazing. Capability subclass IVw nonirrigated ; woodland subclass 2w.

Springdale Series

The Springdale series consists of somewhat excessively drained, nearly level to steep soils formed in glacial outwash derived from acid igneous rocks, mostly granite. These soils are on terraces and old alluvial fans at elevations of 1,400 to 2,100 feet. The vegetation is mainly ponderosa pine, Oregongrape, bluebunch wheatgrass, and pinegrass. The annual precipitation is 17 to 20 inches. The mean annual air temperature is about 46° F. The frost-free period is 110 to 130 days. Springdale soils are associated with the Bisbee variant and Scala soils.

In a representative profile, a thin layer of decaying needles, leaves, twigs, and cones is at the surface. Next, in sequence downward, is 5 inches of dark-gray and dark grayish-brown gravelly loam, 7 inches of brown gravelly coarse sandy loam, and 6 inches of pale-brown gravelly loamy coarse sand. Below this to a depth of 60 inches or more is multicolored very gravelly loamy coarse sand.

Permeability is moderately rapid. Available water capacity is very low. Roots extend to a depth of 60 inches or more.

Springdale soils are used as woodland and sites for summer cabins. They also provide grazing.

Representative profile of Springdale gravelly loam, 0 to 15 percent slopes, in an area 3,432 feet east and 1,056 feet south of the northwest corner of sec. 2, T. 39 N., R. 36 E.

O1-1/2inch to 0, undecomposed needles, twigs, and grass.

A11-0 to 1 inch, dark-gray (10YR 4/1) gravelly loam, black (10YR 2/1) moist; weak, medium, granular structure; soft, very friable, nonsticky and slightly plastic; common roots ; 15 to 20 percent gravel ; medium acid; abrupt, smooth boundary. 0 to 1 inch thick.

A12-1 inch to 5 inches, dark grayish-brown (10YR 4/2) gravelly loam, very dark brown (10YR 2/2) moist ; weak, medium, granular structure; soft, very friable, nonsticky and slightly plastic; common fine and medium and few very fine roots; 15 to 20 percent gravel and 20 percent cobbles and stones; slightly acid; clear, smooth boundary. 4 to 7 inches thick.

AC-5 to 12 inches, brown (10YR 5/3) gravelly coarse sandy loam, dark brown (10YR 3/3) moist; weak, fine, subangular blocky structure; soft, very friable, nonsticky and nonplastic; common roots; 25 to 35 percent gravel; slightly acid; clear, wavy boundary. 4 to 10 inches thick.

C1-12 to 18 inches, pale-brown (10YR 6/3) gravelly loamy coarse sand, brown or dark brown (10YR 4/3) moist; single grained; loose; common roots; 35 to 45 percent gravel; slightly acid; clear, wavy boundary. 6 to 10 inches thick.

C2-18 to 60 inches, multicolored very gravelly loamy coarse sand; single grained; loose; few roots; medium acid. Many feet thick.

Depth to gravelly loamy coarse sand ranges from 8 to 25 inches. The content of gravel increases with increasing depth from about 15 to 65 percent. The A horizon ranges from dark gray to dark grayish brown or grayish brown and from gravelly sandy loam to gravelly loam. Some layers are as much as 20 percent cobbles and stones.

SlC-Springdale gravelly loam, 0 to 15 percent slopes. This is a nearly level to strongly sloping soil on terraces and alluvial fans. It has the profile described as representative of the series. Included in mapping are small areas where the surface layer is sandy loam and depth to the gravelly loamy coarse sand is more than 25 inches. Runoff is very slow to medium, and the erosion hazard is slight or moderate. This soil provides grazing. It is also used as woodland and recreation sites. Capability unit Vle-3 nonirrigated, IVs-1 irrigated; woodland subclass 4f.

SmE-Springdale stony sandy loam, 0 to 45 percent slopes. This is a nearly level to steep soil on dissected terraces and alluvial fans. It has a profile similar to the one described as representative of the series, but the surface layer differs in texture and is about 4 or 5 inches thick and the gravelly loamy coarse sand is about 8 inches below the surface. Included in mapping are escarpments and small areas where boulders are on the surface. Runoff is slow to rapid, and the erosion hazard is slight to severe. The soil is used for grazing and woodland. Capability unit VIe-2 nonirrigated; woodland subclass 4f.

Stevens Series

The Stevens series consists of well-drained, nearly level to steep soils formed in volcanic ash over glacial till, mainly argillite and quartzite material. These soils are on uplands at elevations of 1,700 to 3,000 feet. The vegetation is mainly bluebunch wheatgrass, Idaho fescue, snowberry, ponderosa pine, and Douglas-fir. The annual precipitation is 17 to 20 inches. The mean annual air temperature is about 45° F. The frost-free period is 100 to 130 days. Stevens soils are associated with Molcal soils.

In a representative profile, the surface layer is dark grayish-brown silt loam to a depth of 15 inches. Between depths of 15 and 27 inches is brown silt loam. Below this is 11 inches of brown loam. The underlying material to a depth of 60 inches or more is brown gravelly loam.

Permeability is moderate. Available water capacity is moderately high or high. Roots penetrate to a depth of 60 inches or more.

Stevens soils are used for grazing, hay, small grain, and wildlife.

Representative profile of Stevens silt loam, 15 to 25 percent slopes, in a cultivated area 2,310 feet east and 1,320 feet south of the northwest corner of sec. 30, T. 35 N., R. 37 E.

Ap-0 to 6 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak, very fine and fine, granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; 5 percent gravel; neutral; clear, smooth boundary. 6 to 8 inches thick.

A1-6 to 15 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak, very fine, subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; 5 percent gravel; neutral; clear, wavy boundary. 7 to 11 inches thick.

IIB21-15 to 27 inches, brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; moderate, medium, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; common very fine pores; 5 percent gravel; neutral; clear, wavy boundary. 7 to 12 inches thick.

IIB22-27 to 38 inches, brown (10YR 5/3) loam, dark yellowish brown (10YR 3/4) moist; few, fine, faint, strong brown (7.5YR 3/4) stains; moderate, medium, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; common very fine pores; 15 percent gravel; neutral; gradual, wavy boundary. 10 to 12 inches thick.

IIC-38 to 60 inches, brown (10YR 5/3) gravelly loam, dark brown (10YR 3/3) moist; massive; slightly hard, friable, slightly sticky and plastic; few very fine and fine roots; common very fine pores; 40 to 50 percent gravel; neutral.

The A horizon is dark gray or dark grayish brown. The IIB horizon is silt loam or gravelly loam. The IIC horizon is gravelly loam or gravelly sandy loam. A few cobbles and stones commonly occur throughout the soil.

StC-Stevens silt loam, 8 to 15 percent slopes. This strongly sloping soil is on uplands. Included in mapping are small areas where the dark grayish-brown surface layer is as thick as 28 inches and areas where the slope is less than 8 percent. Runoff is medium, and the erosion hazard is moderate. This soil is used for grass, alfalfa, wheat, and barley. Capability unit IIIe-1 nonirrigated ; Loamy range site.

StD-Stevens silt loam, 15 to 25 percent slopes. This moderately steep soil is on uplands. It has the profile described as representative of the series. A few small areas where the slope is steep and argillite rock crops out are included in mapping. Runoff is medium, and the erosion hazard is moderate. The soil is used for grass, alfalfa, wheat, and grazing. Capability unit IVe-1 nonirrigated; Loamy range site.

SvE-Stevens stony silt loam, 0 to 45 percent slopes. This nearly level to steep soil is on uplands. It has a profile similar to the one described as representative of the series, but stones and cobbles cover 0.1 to 3 percent of the surface area. A few small areas of argillite rock outcrop are included in mapping. Runoff is slow to rapid, and the erosion hazard is slight to severe. All the acreage is used for grazing and wildlife. Capability unit VIe-1 nonirrigated ; Loamy range site.

Talls Series

The Talls series consists of well-drained, nearly level to steep soils formed in volcanic ash over glacial till, including reworked lake sediments. These soils are on mountainous uplands at elevations of 2,500 to 4,500 feet. The vegetation is mainly Douglas-fir, western larch, ponderosa pine, and lodgepole pine. The annual precipitation is 17 to 24 inches. The mean annual air temperature is about 43° F. The frost-free period is 90 to 120 days. Talls soils are associated with Goddard, Merkel, and Nevine soils.

In a representative profile, a thin layer of needles, twigs, and grass overlies a 1/4-inch layer of gray loam. Next, in sequence downward, is about 5 inches of pale-brown loam, 8 inches of light yellowish-brown loam, 23 inches of pale-brown and light brownish-gray very

gravelly loam, and 12 inches of light-gray gravelly loam. Below this to a depth of 60 inches or more is light-gray gravelly sandy loam.

Permeability is moderately slow. Available water capacity is low or moderate. Roots penetrate to a depth of 60 inches or more.

Tails soils are used for woodland, wildlife, and grazing.

Representative profile of Talls loam, 0 to 30 percent slopes, in a forested area 100 feet east and 20 feet north of the southwest corner of sec. 21, T. 39 N., R. 33 E.

O1-1 inch to 0, partly decomposed needles, twigs, grass; neutral.

A2-0 to 1/4 inch, gray (10YR 6/1) loam, dark gray (10YR 4/1) moist; neutral; abrupt, smooth boundary. 0 to 1 inch thick.

B21-1/4 inch to 5 inches, pale-brown (10YR 6/3) loam, dark brown (10YR 4/3) moist; weak, medium, granular structure; soft, very friable, slightly sticky and slightly plastic; many roots; neutral; clear, smooth boundary. 4 to 10 inches thick.

B22-5 to 13 inches, light yellowish-brown (10YR 6/4) loam, dark yellowish brown (10YR 4/4) moist; weak, medium, subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many roots; common fine and very fine pores; neutral; abrupt, wavy boundary. 6 to 15 inches thick.

IIA2b-13 to 23 inches, pale-brown (10YR 6/3) very gravelly heavy loam, brown or dark brown (10YR 4/3) moist; massive; hard, friable, slightly sticky and plastic; common roots; many fine and very fine pores ; thin distinct clay bands, dark yellowish brown (10YR 4/4) moist; 50 percent gravel and 25 percent stones and cobbles; slightly acid; gradual, smooth boundary. 8 to 20 inches thick.

IIB2bt-23 to 36 inches, light brownish-gray (10YR 6/2) very gravelly heavy loam, dark grayish brown (10YR 4/2) moist; massive; hard, friable, slightly sticky and plastic; common roots; many medium and fine pores; medium distinct clay bands, dark yellowish brown (10YR 4/4) moist; 50 percent gravel and 25 percent stones and cobbles; slightly acid; gradual, smooth boundary. 10 to 20 inches thick.

IIC1-36 to 48 inches, light-gray (2.5Y 7/2) gravelly loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few roots; few fine pores; 25 percent gravel and 25 percent stones and cobbles; slightly acid; clear, smooth boundary. 10 to 15 inches thick.

IIC2-48 to 60 inches, light-gray (2.5Y 7/2) gravelly sandy loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few roots; 25 percent gravel; neutral. 6 to 20 inches thick.

The A and B horizons are more than 60 percent pyroclastic material and less than 15 percent coarse fragments. Depth to the glacial till ranges from 10 to 26 inches. The horizons formed in glacial till are by volume more than 35 percent coarse fragments and 18 to 25 percent clay. Reaction above the C horizon is slightly acid to moderately alkaline. The B horizon is silt loam or loam. The horizons formed in glacial till are clay loam, sandy loam, sandy clay loam, or loam and are gravelly, very gravelly, or very cobbly. They have a few clay bands 1/8 to 1/4 inch thick.

TaD-Talls loam, 0 to 30 percent slopes. This is a nearly level to steep soil on mountainsides. It has the profile described as representative of the series. Runoff is slow to rapid, and the erosion hazard is slight to severe. This soil is used for woodland, wildlife, and grazing. Capability unit IVe-2 nonirrigated; woodland subclass 4o.

TaE-Talls loam, 30 to 45 percent slopes. This is a steep soil on mountainsides. Runoff is rapid, and the erosion hazard is severe. This soil is used as woodland and wildlife habitat. Capability unit VIe-2 nonirrigated; woodland subclass 4r.

TcE-Talls stony loam, 0 to 45 percent slopes. This is a nearly level to steep soil on mountainsides. It has a profile similar to the one described as representative of the series, but large stones cover about 2 percent of the surface area. Runoff is slow to rapid, and the erosion hazard is slight to severe. This soil is used as woodland and wildlife habitat. Capability unit VIe-2 nonirrigated; woodland subclass 4f.

Tenas Series

The Tenas series consists of well-drained, moderately steep and very steep soils underlain by andesite bedrock at a depth of 20 to 40 inches. These soils formed in volcanic ash over weathered andesite bedrock. They are on mountain uplands at elevations of 3,000 to 6,000 feet. The vegetation is mainly bluebunch wheatgrass, Idaho fescue, pinegrass, and ponderosa pine. The annual precipitation is 25 to 35 inches. The mean annual air temperature is 38° to 42° F. The frost-free period is 80 to 100 days. Tenas soils are associated with Edds, Growden, and Leonardo soils.

In a representative profile, the upper 6 inches is very dark gray loam. It is underlain by 6 inches of very dark-brown gravelly loam. Below this is 18 inches of dark-reddish-gray gravelly clay loam and reddish-gray extremely stony clay loam. Bedrock is at a depth of about 30 inches. Permeability is moderate. Available water capacity is low. Roots penetrate as far down as bedrock.

Tenas soils are used for grazing, wildlife, and woodland.

Representative profile of Tenas loam, 15 to 35 percent slopes, under grass, NW1/4NW1/4 sec. 6, T. 38 N., R. 32 E. On forest road to Bodie Mountain Lookout; the first easterly switchback downhill from Lookout; the uphill side of road:

O2-1 inch 0, decomposed litter.

A11--0 to 6 inches, very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; weak, fine, granular structure; soft, friable, nonsticky and nonplastic; many fine roots; 10 percent gravel; slightly acid; clear, wavy boundary. 5 to 8 inches thick.

A12-6 to 12 inches, very dark brown (10YR 2/2) gravelly loam, black (10YR 2/1) moist; weak, fine, granular structure; soft, friable, nonsticky and nonplastic; many fine roots; slightly acid; clear, wavy boundary. 5 to 8 inches thick.

IIB1-12 to 14 inches, dark reddish-gray (5YR 4/2) gravelly clay loam, dark reddish brown (5YR 2/2) moist; moderate, medium and fine, subangular blocky structure; slightly hard, firm, sticky and slightly plastic; few fine roots; 30 percent gravel and stones; medium acid; clear, smooth boundary. 2 to 3 inches thick.

IIB2-14 to 30 inches, reddish-gray (5YR 5/2) extremely stony clay loam, dark reddish brown (5YR 3/2) moist; moderate, medium and fine, subangular blocky structure; slightly hard, firm, sticky and plastic; few fine roots; 35 percent stones; medium acid; abrupt, smooth boundary. 8 to 18 inches thick.

IIR-30 inches, fractured andesite bedrock.

The mean annual soil temperature at a depth of 20 inches is 38° to 42° F, and the mean summer temperature is less than 47°. The A horizon is dominated by volcanic ash. The

B horizon is about 20 to 30 percent clay. The depth to bedrock ranges from 20 to 40 inches. The Al horizon is loam or silt loam and in places is gravelly. It is neutral or slightly acid. The B horizon is medium acid or strongly acid.

TeE-Tenas loam, 15 to 35 percent slopes. This moderately steep to steep soil is on mountainsides. It has the profile described as representative of the series. Included in mapping are small areas of Inkier and Cobey soils. Runoff is medium or rapid, and the erosion hazard is moderate or severe. This soil is used for grazing, woodland, and wildlife. Capability subclass IVe nonirrigated; Loamy range site; woodland subclass 4d.

TeF-Tenas loam, 35 to 65 percent slopes. This steep to very steep soil is on mountainsides. Runoff is rapid or very rapid, and the erosion hazard is severe or very severe. This soil is used for grazing, woodland, and wildlife. Capability subclass VIe nonirrigated ; Loamy range site; woodland subclass 4d.

TkE-Tenas-Rock land complex, 15 to 50 percent slopes. This moderately steep to very steep mapping unit is on mountainsides. It is 40 to 70 percent Tenas soil and 30 to 60 percent Rock land. Rock land is 50 to 90 percent rock outcrop and 10 to 50 percent very shallow soils. Runoff is medium to very rapid, and the erosion hazard is moderate to very severe. This mapping unit is used for grazing, woodland, and wildlife. Capability subclass VIIs nonirrigated; Loamy range site; woodland subclass 4d for Tenas soil, 5x for Rock land.

TmF-Tenas-Vallan complex, 35 to 65 percent slopes. This steep to very steep mapping unit is on mountainsides. It is 40 to 70 percent Tenas soil and 30 to 60 percent Vallan soil. The Vallan soil is described under the heading Vallan Series. Runoff is rapid or very rapid, and the erosion hazard is severe or very severe. This soil is used for grazing, woodland, and wildlife. Capability subclass VIIs nonirrigated; Loamy range site, woodland subclass 4d for Tenas soil ; Shallow range site, woodland subclass 5d for Valan soil.

Togo Series

The Togo series consists of well-drained, moderately steep and very steep soils formed in volcanic ash over glacial till and granitic colluvium. These soils are on mountainous uplands at elevations of 4,000 to 6,500 feet. The vegetation is mainly subalpine fir, Douglas-fir, western larch, and aspen. The annual precipitation is 30 to 45 inches. The mean annual air temperature is 38° to 40° F. The frost-free period is 70 to 90 days. Togo soils are associated mainly with Scar and Bamber soils.

Beneath the litter and humus in a representative profile is 18 inches of loam. The upper 1 1/2 inches is gray, the next 7 1/2 inches is dark brown. and the lower 9 inches is dark brown and gravelly. The underlying material is brown gravelly sandy loam to a depth of 34 inches and very gravelly sandy loam to a depth of 60 inches or more.

Permeability is moderate. Available water capacity is low. Roots penetrate to a depth of 60 inches or more.

Togo soils are used for woodland, wildlife, and graz ing.

Representative profile of Togo loam, 15 to 35 percent slopes, in a forested area, SE1/4SE1/4NW1/4 sec. 17, T. 37 N., R. 35 E., 1.9 miles up Twin Sisters Lookout Road from Mack Mountain Road Junction

O1-2 inches to 1 inch, leaves, needles, and twigs.

02-1 inch to 0, decomposed leaves, needles, and twigs.

A2-0 to 1 1/2 inches, gray (10YR 5/1) loam, light gray (10YR 7/1) dry; common, fine, distinct mottles, dark brown (7.5YR 3/2) moist; massive; slightly hard, friable, nonsticky and nonplastic; common fine and medium roots; few fine tubular pores; 5 percent angular cobbles and 5 percent gravel; few fine charcoal fragments; neutral; abrupt, wavy boundary. 1/2 inch to 3 inches thick.

B2ir-1 1/2 to 9 inches, dark-brown (7.5YR 4/4) loam, very pale brown (10YR 7/4) dry; weak, fine and medium, subangular blocky structure; slightly hard, friable, nonsticky and slightly plastic; common fine and medium roots; few fine tubular pores; 10 percent gravel and 5 percent angular cobbles; neutral ; clear, wavy boundary. 6 to 10 inches thick.

B3-9 to 18 inches, dark-brown (7.5YR 4/4) and brown (10YR 5/3) gravelly loam, light yellowish brown (10YR 6/4) dry; weak, medium, subangular blocky structure; slightly hard, friable, nonsticky and slightly plastic; common fine and medium roots; few fine pores; 20 percent gravel and 5 percent angular cobbles; neutral; clear, irregular boundary. 6 to 12 inches thick.

IIC1-18 to 34 inches, brown (10YR 5/3) gravelly sandy loam, pale brown (10YR 6/3) dry; 40 percent dark-brown (7.5YR 4/4) vertical extensions of B3 horizon; massive; hard, very friable, nonsticky and nonplastic; common fine and medium roots; few fine tubular pores; 40 percent gravel and cobbles ; medium acid; gradual, irregular boundary. 12 to 18 inches thick.

IIC2-34 to 60 inches, brown (10YR 5/3) very gravelly sandy loam, pale brown (10YR 6/3) dry; 20 percent dark-brown (7.5YR 4/4) vertical extensions of B3 horizon; massive; hard, very friable, nonsticky and nonplastic; few medium roots; 80 percent gravel and cobbles; medium acid.

Depth to bedrock exceeds 40 inches. The upper 18 inches is more than 60 percent volcanic ash in the fine earth fraction and less than 35 percent coarse fragments by weighted average. The IIC horizon is 35 to 70 percent coarse fragments. The A2 and B2ir horizons are loam or silt loam and in places are gravelly or cobbly. The IIC horizon is gravelly, very gravelly, cobbly, or very cobbly sandy loam.

TnE-Togo loam, 15 to 35 percent slopes. This is a moderately steep to steep soil on mountainsides. It has the profile described as representative of the series. Runoff is medium to rapid, and the erosion hazard is moderate or severe. This soil is used as woodland and wildlife habitat. It also provides limited grazing. Capability subclass IVe nonirrigated; woodland subclass 3o.

TnF-Togo loam, 35 to 65 percent slopes. This is a steep to very steep soil in mountainous areas. Runoff is rapid or very rapid, and the erosion hazard is severe or very severe. This soil is used as woodland and wildlife habitat. It also provides limited grazing. Capability subclass VIe nonirrigated; woodland subclass 3r.

ToF-Togo-Bamber complex, 35 to 65 percent slopes. This is a steep to very steep mapping unit in mountainous areas. It is about 40 to 70 percent Togo soil and 30 to 60 percent Bamber soil. The Bamber soil is described under the heading Bamber Series. Small areas of Leonardo, Pepoon, Growden, and Edds soils are included in mapping. Runoff is rapid or very rapid, and the erosion hazard is severe or very severe. This mapping unit is used for woodland, wildlife, and grazing. Capability subclass VIe nonirrigated; woodland subclass 3r for Togo soil, 4f for Bamber soil.

TrE-Togo-Rock land complex, 15 to 50 percent slopes. This is a moderately steep to very steep mapping unit on mountainsides. It is 40 to 70 percent Togo soil and 30 to 60 percent Rock land. Rock land is 50 to 90 percent rock outcrop and 10 to 50 percent very shallow soils. Runoff is medium to very rapid, and the erosion hazard is moderate to very severe. This mapping unit is used as woodland and wildlife habitat. Capability subclass VIIs nonirrigated; woodland subclass 3r for Togo soil, 5x for Rock land.

Tonata Series

The Tonata series consists of poorly drained, nearly level soils formed in alluvium. These soils are along streams and in depressions at elevations of 3,500 to 5,500 feet. The vegetation is mainly redcedar. The annual precipitation is 30 to 35 inches. The mean annual air temperature is 39° to 42° F. The frost-free period is 80 to 100 days. Tonata soils are associated with Shaskit, Gahee, and Manley soils.

In a representative profile, the soil is silt loam throughout. The upper 3 inches is dark gray, the next 6 inches is gray, and the next 7 inches is dark gray mottled with brown. Below this to a depth of 60 inches the soil is gray and is distinctly mottled with dark brown.

Permeability is slow. Available water capacity is high. Roots penetrate mostly to the seasonal water table at a depth of 2 to 4 feet.

Tonata soils are used for woodland, wildlife, and grazing.

Representative profile of Tonata silt loam in a forested area, SE1/4NW1/4 sec. 5, T. 35 N., R. 33 E., 500 yards north on logging spur off Quartz Mountain road; 20 yards east of spur:

A11-0 to 3 inches, dark-gray (10YR 4/1) silt loam, black (10YR 2/1) moist; moderate, medium and coarse, granular structure; slightly hard, friable, slightly sticky and nonplastic; many fine roots; neutral; abrupt, smooth boundary. 3 to 4 inches thick.

A12-3 to 9 inches, gray (10YR 5/1) silt loam, very dark brown (10YR 2/2) moist; moderate, medium, angular blocky structure; slightly hard, firm, slightly sticky and nonplastic; few large roots; many pieces of deadwood ; neutral ; clear, wavy boundary. 5 to 7 inches thick.

Blg-9 to 16 inches, dark-gray (10YR 4/1) silt loam, very dark brown (10YR 2/2) moist; few, fine, distinct mottles, dark brown (10YR 4/3) moist; moderate, coarse, angular blocky structure; slightly hard, firm, slightly sticky and nonplastic; neutral; clear, wavy boundary. 7 to 9 inches thick.

B2g-16 to 60 inches, gray (10YR 5/1) silt loam, very dark grayish brown (10YR 3/2) moist; common, fine, distinct mottles, dark brown (10YR 4/3) moist; moderate, coarse, angular blocky structure; slightly hard, firm, slightly sticky and nonplastic; common fine soft manganese concretions; thin lenses of silty clay loam and sand; neutral.

The upper 40 inches is volcanic ash. Reaction is neutral or slightly acid. In places sandy and gravelly glacial outwash alluvium or glacial till is below a depth of 40 inches. In some areas thin lenses of sand and gravel occur between depths of 10 and 40 inches.

Ts-Tonata silt loam. This nearly level soil is on bottom land. It has the profile described as representative of the series. Included in mapping are a few areas of Marsh and peat. Runoff is very slow, and there is no hazard of erosion. This mapping unit is used for woodland, wildlife, and grazing. Capability subclass IVw nonirrigated ; woodland subclass 2w.

Torboy Series

The Torboy series consists of well-drained, nearly level to very steep soils formed in volcanic ash and glacial outwash derived mainly from volcanic rocks. These soils are on terraces and terrace edges at elevations of 3,000 to 4,500 feet. The vegetation is mainly Douglas-fir, western larch, ponderosa pine, and lodgepole pine. The annual precipitation is 15 to 30 inches. The mean annual air temperature is about 42° F. The frost-free period is 90 to 120 days. Torboy soils are associated with Goddard, Merkel, and Nevine soils.

In a representative profile under a thin layer of partly decomposed needles and twigs is 17 inches of pale-brown sandy loam. The uppermost quarter of an inch is white. Beneath this is light brownish-gray gravelly loamy sand to a depth of 24 inches and multicolored gravelly sand to a depth of 60 inches or more.

Permeability is moderately rapid. Available water capacity is low to moderately high. Roots penetrate to a depth of 60 inches or more.

Torboy soils are used for woodland, wildlife, and grazing.

Representative profile of Torboy sandy loam, 0 to 5 percent slopes, in woodland 50 feet south of old west fork road and 0.2 miles northeast of its junction with the west fork of Trout Creek Road, 2,050 feet east and 1,450 feet south of northwest corner of sec. 35, T. 38 N., R. 32 E.

O1-1 inch to 0, partly decomposed needles and twigs.

A2-0 to 1/4 inch, white (10YR 8/1) sandy loam, light gray (10YR 6/1) moist; weak, coarse, granular structure; soft, very friable, nonsticky and nonplastic; many roots; neutral; abrupt, smooth boundary. 0 to 1/2 inch thick.

B21-1/4 inch to 6 inches, pale-brown (10YR 6/3) sandy loam, brown (10YR 4/3) moist; weak, medium, subangular blocky structure; soft, very friable, nonsticky and nonplastic; many roots; 10 percent gravel by volume; slightly acid; clear, wavy boundary. 3 to 8 inches thick.

B22-6 to 17 inches, pale-brown (10YR 6/3) sandy loam, dark yellowish brown (10YR 4/4) moist; weak, medium, subangular blocky structure; very friable, nonsticky and nonplastic; common roots; few fine pores; 10 percent fine gravel; slightly acid; abrupt, wavy boundary. 6 to 15 inches thick.

IIC1-17 to 24 inches, light brownish-gray (10YR 6/2) gravelly loamy sand, dark grayish brown (10YR 4/2) moist; many, medium, distinct mottles, dark yellowish brown (10YR 4/4) moist; massive; soft, very friable, nonsticky and nonplastic; common roots; 25 percent gravel; slightly acid; abrupt, smooth boundary. 4 to 10 inches thick.

IIC2-24 to 32 inches, multicolored gravelly sand; single grained; loose, nonsticky and nonplastic; few roots; 35 percent gravel and 10 percent cobbles; neutral; gradual, wavy boundary. 8 to 14 inches thick.

IIC3-32 to 60 inches, multicolored gravelly sand; single grained; loose, nonsticky and nonplastic; few roots; 25 percent gravel; neutral.

The content of coarse fragments between depths of 10 and 40 inches ranges from 10 to 35 percent. The A2 and B horizons are neutral or slightly acid and are sandy loam or gravelly sandy loam.

TtB-Torboy sandy loam, 0 to 5 percent slopes. This is a nearly level to gently sloping soil on terraces. It

has the profile described as representative of the series. Included in mapping are small areas where the surface layer is gravelly sandy loam and small areas where sand is at a depth of about 18 inches. Runoff is very slow or slow, and the erosion hazard is slight. This soil is used for woodland, wildlife, and grazing. Capability unit IVs-2 nonirrigated ; woodland subclass 4o.

TtD-Torboy sandy loam, 5 to 25 percent slopes. This is a gently sloping to moderately steep soil at terrace edges. Runoff is slow or medium, and the erosion hazard is slight or moderate. This soil is used for woodland, wildlife, and grazing. Capability unit VIe-2 nonirrigated; woodland subclass 3o.

TtF-Torboy sandy loam,. 25 to 65 percent slopes. This is a steep to very steep soil at terrace edges. Runoff is rapid or very rapid, and the erosion hazard is severe or very severe. This soil is used for woodland, wildlife, and grazing. Capability subclass VIe nonirrigated; woodland subclass 3r.

TuF-Torboy cobbly sandy loam, 25 to 65 percent slopes. This is a steep to very steep soil on sides of terraces. It has a profile similar to the one described as representative of the series, but it is about 20 percent cobbles. Runoff is rapid or very rapid, and the erosion hazard is severe or very severe. This soil is used as woodland and wildlife habitat. Capability unit VIIe-1 nonirrigated; woodland subclass 4r.

Toroda Series

The Toroda series consists of well-drained, moderately steep to steep soils formed in volcanic ash over glacial till and alluvium derived from andesite rock. These soils are on mountainous uplands at elevations of 4,000 to 6,000 feet. The vegetation is mainly Kentucky bluegrass and Sandberg bluegrass in open parks and ponderosa pine in close-growing patches. The annual rainfall is 25 to 35 inches. The mean annual air temperature is 39° to 41° F. The frost-free period is 90 to 100 days. Toroda soils are associated with Edds and Tenas soils.

In a representative profile, the upper 23 inches is very dark gray and very dark brown silt loam. Below this to a depth of 60 inches or more is grayish-brown gravelly clay loam.

Permeability is moderate. Available water capacity is low to moderately high. Roots penetrate to a depth of 60 inches or more.

Toroda soils are used for grazing and wildlife.

Representative profile of Toroda silt loam, 15 to 35 percent slopes, under grass, but formerly cultivated, NW1/4SW1/4 sec. 6, T. 38 N., R. 32 E., 200 yards northwest upslope from cabin at lower end of clearing on south slope of Bodie Mountain:

Ap-0 to 11 inches, very dark gray (10YR 3/1) silt loam, black (10YR 2/1) moist; weak, medium and fine, granular structure; slightly hard, friable, nonsticky and nonplastic; many fine roots; 10 percent gravel; slightly acid; abrupt, smooth boundary. 10 to 12 inches thick.

A1-11 to 23 inches, very dark brown (10YR 2/2) gravelly silt loam, black (10YR 2/1) moist; weak, medium and coarse, blocky structure; soft, friable, nonsticky and nonplastic; common fine roots; 35 percent gravel; slightly acid; clear, wavy boundary. 10 to 12 inches thick.

IIB1-23 to 36 inches, grayish-brown (10YR 5/2) gravelly clay loam, dark brown (10YR 3/3) moist; moderate, medium and fine, subangular blocky structure; slightly hard, friable, sticky and slightly plastic; few fine roots; 40 percent gravel; slightly acid; clear, wavy boundary. 11 to 14 inches thick.

IIB2-36 to 60 inches, grayish-brown (10YR 5/2) gravelly clay loam, dark grayish brown (10YR 4/2) moist; moderate, medium and fine, blocky structure; hard, firm, sticky and plastic; few fine roots; 35 percent gravel and 15 percent stones and cobbles; neutral.

The mean annual temperature ranges from 39° to 45° F, and the mean summer temperature is less than 59°. The A horizon is more than 60 percent volcanic ash in the fine earth fraction. The IIB horizon is loam or clay loam and is gravelly, cobbly, or stony.

TvE-Toroda silt loam, 15 to 35 percent slopes. This moderately steep to steep soil is on mountainsides. It has the profile described as representative of the series. Included in mapping are small areas where the slope is greater than 35 percent. Also included are small areas of Pepoon, Koepke, Vallan, and Tenas soils. Runoff is medium or rapid, and the erosion hazard is moderate or severe. This soil is used for grazing and wildlife. Capability subclass IVe nonirrigated; Loamy range site; woodland subclass 4o.

Vallan Series

The Vallan series consists of well-drained, moderately steep to very steep soils underlain by andesite bedrock at a depth of 6 to 20 inches. These soils formed in weathered andesite, glacial till, and volcanic ash. They are on mountain ridges, knobs, and hilltops at elevations of 3,000 to 5,500 feet. The vegetation is mainly bluebunch wheatgrass, Idaho fescue, bluegrass, and scattered Douglas-fir and ponderosa pine. The annual precipitation is 15 to 25 inches. The mean annual air temperature is about 43° F. The frost-free period is 70 to 120 days. Vallan soils are associated with Koepke, Molson, Nevine, and Hum soils.

In a representative profile, 16 inches of loam overlies andesite bedrock. The upper 2 inches is brown, the next 8 inches is yellowish brown, and the lower 6 inches is brown and is slightly more clayey than the layers above.

Permeability is moderate. Available water capacity is very low. Roots penetrate to bedrock at a depth of 6 to 20 inches.

Vallan soils are used for grazing, wildlife, and woodland.

Representative profile of Vallan loam, 15 to 35 percent slopes, in grassland 500 feet east and 400 feet south of the northwest corner of SW1/4NE1/4 sec. 26, T. 37 N., R. 32 E.

A1-0 to 2 inches, brown (10YR 5/3) loam, . very dark grayish brown (10YR 3/2) moist; moderate, fine, granular structure; soft, very friable, slightly sticky and slightly plastic; many roots; neutral; abrupt, smooth boundary. 1 inch to 3 inches thick.

B21-2 to 10 inches, yellowish-brown (10YR 5/4) loam, dark yellowish brown (10YR 3/4) moist; moderate, fine and medium, granular structure; soft, very friable, slightly sticky and slightly plastic; many roots; slightly acid; clear, smooth boundary. 3 to 10 inches thick.

B22t-10 to 16 inches, brown (7.5YR 5/4) heavy loam, dark brown (7.5YR 3/4) moist; moderate, medium, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common roots; common fine and medium pores; thin to moderately thick

clay films in pores and on peds; 15 percent angular and rounded gravel and stones; slightly acid; abrupt, wavy boundary. 2 to 10 inches thick.

R-16 inches, hard, slightly weathered andesite bedrock.

Depth to bedrock ranges from 6 to 20 inches. The content of coarse fragments ranges from 5 to 25 percent. The Bt horizon ranges from heavy loam to clay loam.

VaE-Vallan loam, 15 to 35 percent slopes. This is a moderately steep to steep soil in mountainous areas. It has the profile described as representative of the series. Runoff is medium or rapid, and the erosion hazard is moderate or severe. The entire acreage is used for grazing and wildlife. Capability subclass VIIs nonirrigated; Shallow range site; woodland subclass 5d.

VaF-Vallan loam, 35 to 65 percent slopes. This is a steep to very steep soil on mountainsides. Runoff is rapid or very rapid, and the erosion hazard is severe or very severe. All the acreage is used for grazing and wildlife. Capability subclass VIIs nonirrigated; Shallow range site; woodland subclass 5d.

VbF-Vallan-Bamber complex, 35 to 65 percent slopes. This is a steep to very steep mapping unit on mountainsides. It is 40 to 70 percent Vallan soil and 30 to 60 percent Bamber soil. The Bamber soil is described under the heading Bamber Series. Runoff is rapid or very rapid, and the erosion hazard is severe or very severe. The entire acreage is used for grazing and wildlife. Capability subclass VIIs nonirrigated; Shallow range site; woodland subclass 5d for Vallan soil, 4f for Bamber soil.

VrE-Vallan-Rock land complex, 15 to 50 percent slopes. This is a moderately steep to very steep mapping unit on rounded knobs, ridges, and hilltops. It is 40 to 70 percent Vallan soil and 30 to 60 percent Rock land. Rock land is 50 to 90 percent rock outcrop and 10 to 50 percent very shallow soils. Included in mapping are small areas of Molson and Nevine soils. Runoff is medium to very rapid, and the erosion hazard is moderate to very severe. All the acreage is used for grazing and wildlife. Capability unit VIIs-1 nonirrigated; Shallow range site; woodland subclass 5d for Vallan soil, 5x for Rock land.

VtF-Vallan-Tenas complex, 35 to 65 percent slopes. This is a steep to very steep mapping unit in mountainous areas and on ridges. It is 40 to 70 percent Vallan soil and 30 to 60 percent Tenas soil. The Tenas soil is described under the heading Tenas Series. Runoff is rapid or very rapid, and the erosion hazard is severe or very severe. The entire acreage is used for grazing and wildlife. Capability subclass VIIs nonirrigated ; Shallow range site, woodland subclass 5d for Vallan soil; Loamy range site, woodland subclass 4d for Tenas soil.

Wapal Series

The Wapal series consists of somewhat excessively drained, nearly level to very steep soils formed in glacial outwash. These soils are on long, narrow eskers and sides of kames at elevations of 3,000 to 4,500 feet. The vegetation is mainly Douglas-fir, ponderosa pine, western larch, and lodgepole pine. The annual precipitation is 17 to 24 inches. The mean annual air temperature is about 42° F. The frost-free period is 90 to 120 days. Wapal soils are associated with Goddard, Merkel, Nevine, and Torboy soils.

Under a litter of needles, twigs, bark, and grass in a representative profile is 10 inches of sandy loam. The upper 3 inches is brown, and the lower 7 inches is yellowish brown. Below this is 9 inches of light yellowish-brown coarse sandy loam. The underlying material to a depth of 60 inches or more is multicolored gravelly coarse sand.

Permeability is moderately rapid in the sandy loam and very rapid in the gravelly sand. Available water capacity is low. Roots extend to a depth of 60 inches or more.

Wapal soils are used for wildlife and grazing.

Representative profile of Wapal sandy loam, 25 to 65 percent slopes, in a forested area 1,320 feet east and 1,580 feet north of the southwest corner of sec. 20, T. 36 N., R. 32 E.

O1-1 1/2 inches to 0, undecomposed needles, twigs, bark, and grass. 1 inch to 2 inches thick.

A1-0 to 3 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) moist; weak, very fine and fine, granular structure; soft, very friable, nonsticky and nonplastic; common roots; common fine and very fine pores; 5 percent gravel; neutral; clear, smooth boundary. 3 to 4 inches thick.

B21-3 to 10 inches, yellowish-brown (10YR 5/4) sandy loam, dark yellowish brown (10YR 3/4) moist; weak, fine, subangular blocky structure; soft, very friable, nonsticky and nonplastic; common roots; common fine and very fine pores; 5 percent gravel; slightly acid; gradual, smooth boundary. 3 to 10 inches thick.

B22-10 to 19 inches, light yellowish-brown (10YR 6/4) coarse sandy loam, dark yellowish brown (10YR 4/4) moist; weak, fine, subangular blocky structure; soft, very friable, nonsticky and nonplastic; common roots; common fine and very fine pores; 5 percent gravel; slightly acid; abrupt, wavy boundary. 4 to 9 inches thick.

IIC-19 to 60 inches, multicolored gravelly coarse sand; single grained; loose; few roots; 40 percent gravel and 15 percent cobbles and stones; slightly acid. More than 20 feet thick.

Gravelly coarse sand is at a depth of 10 to 23 inches. The A1 and B2 horizons are sandy loam or gravelly sandy loam.

WaF-Wapal sandy loam, 25 to 65 percent slopes. This steep to very steep soil is on glacial kame terraces. It has the profile described as representative of the series. Included in mapping are small areas where the surface layer is stony, small areas where gravelly sand is at a depth of about 14 inches, and small areas where the slope is less than 25 percent. Runoff is rapid or very rapid, and the erosion hazard is severe or very severe. This soil is used for woodland, wildlife, and grazing. Capability unit VIIe-1 nonirrigated ; woodland subclass 4s.

WgC-Wapal gravelly sandy loam, 0 to 15 percent slopes. This nearly level to strongly sloping soil is on terraces and kames. It has a profile similar to the one described as representative of the series, but the upper 19 inches is 15 to 25 percent gravel. Runoff is very slow to medium, and the erosion hazard is slight or moderate. This soil is used as wildlife habitat. It also provides limited grazing. Capability subclass IVe nonirrigated; woodland subclass 2s.

WgE-Wapal gravelly sandy loam, 15 to 35 percent slopes. This moderately steep to steep soil is on ter-

races and at terrace edges. It has a profile similar to the one described as representative of the series, but the upper 19 inches is 15 to 25 percent gravel. Runoff is medium or rapid, and the erosion hazard is moderate or severe. This soil is used as wildlife habitat. It also provides limited grazing. Capability subclass IVe nonirrigated; woodland subclass 4s.

WgF-Wapal gravelly sandy loam, 35 to 65 percent slopes. This steep to very steep soil is at terrace edges. It has a profile similar to the one described as representative of the series, but the upper 19 inches is 15 to 25 percent gravel. Runoff is rapid or very rapid, and the erosion hazard is severe or very severe. This soil is used as wildlife habitat. It also provides limited grazing. Capability subclass VIIe nonirrigated; woodland subclass 4s.

Use and Management of the Soils

Soils in the North Ferry Area are used for crops, range, wildlife, and woodland. They are also used in engineering projects. This section suggests the general management of the soils for these purposes and describes the soil features affecting these uses. It also describes the capability grouping of soils and the capability units of irrigated and nonirrigated soils on privately owned acreages in the area.

Capability Grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to horticultural crops or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, for forest trees, or for engineering.

In the capability system, the soils can be grouped at three levels: the capability class, the subclass, and the unit. These levels are described in the following paragraphs.

CAPABILITY CLASSES, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are not likely to erode, but have other limitations, impractical to remove, that limit their use largely to pasture or range, woodland, or wildlife.

Class VI soils have severe limitations that make them generally unsuitable for cultivation and limit their use largely to pasture or range, woodland, or wildlife.

Class VII soils have very severe limitations that make them unsuitable for cultivation and that restrict their use largely to pasture or range, land, or wildlife.

Class VIII soils and landforms have limitations that preclude their use for commercial crop production and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes.

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e, w, s, or c,* to the class numeral, for example, IIIe. The letter e shows that the main limitation is risk of erosion; w shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage) ; s shows that the soil is limited mainly because it is shallow, droughty, or stony; and c, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by w, s, and c because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture or range, woodland, wildlife, or recreation.

Soils in the National Forest of the North Ferry Area are classified only by capability subclasses, as shown at the end of the specified mapping unit description and in the Guide to Mapping Units at the back of this publication.

CAPABILITY UNITS are soil groups within the sub classes. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIIe-3 or IVe-2. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation ; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

On the following pages are suggestions, by capability units, on use and management of irrigated and nonirrigated soils on the privately owned acreages of the North Ferry Area.

Management o f nonirrigated soils

The use and management of nonirrigated soils in the

North Ferry Area is governed by climate. A short growing season and lack of summer moisture reduce the number of suitable crops. Only 10 percent of the annual precipitation occurs during the growing season, and most of this evaporates. The principal crops are spring wheat, barley, rye, alfalfa, and grass. In a few places winter wheat can be grown.

Selecting a cropping system that conserves soil and water is effective in improving or maintaining soil tilth and in controlling erosion and weeds, both of which are basic management needs.

CAPABILITY UNIT IIIe-1 NONIRRIGATED

The soils in this unit are well drained. Permeability is moderate or moderately slow. The available water capacity is moderately high or high. Slopes are mostly 3 to 15 percent, but range from 0 to 15 percent. Runoff is very slow to medium, and the hazard of erosion is slight or moderate. The annual precipitation is 14 to 20 inches. The frost-free season is 90 to 135 days.

Small grain, hay, and pasture grasses are the main crops. Wheat and barley are the main grains. Intermediate wheatgrass and alfalfa are the main pasture and hay plants. Winter wheat is susceptible to snow mold.

A common rotation is 3 to 5 years of grain followed by 5 to 10 years of alfalfa. In an alternative rotation, the period in grain is broken every third year by summer fallow for needed weed control. Under this rotation, erosion can be controlled if all crop residue is mixed into the plow layer, all tillage is done across the slope or on the contour, and waterways are shaped and seeded to grass. Chiseling in fall and minimum tillage 6 to 8 times a year also reduce runoff and the risk of erosion.

CAPABILITY UNIT IIIe-2 NONIRRIGATED

The soils in this unit are well drained and moderately well drained. Permeability is moderate or moderately slow. The available water capacity is high. Slopes are mostly 3 to 15 percent, but range from 0 to 15 percent. Runoff is very slow to medium, and the hazard of erosion is slight or moderate. The annual precipitation is 17 to 21 inches. The frost-free season is 110 to 130 days.

Legumes, grass, and small grain are the chief crops. Alfalfa is the chief legume. Winter wheat is better suited than spring wheat.

A suitable cropping system is 5 to 10 years of legumes and grass followed by 1 or 2 years, or possibly 3 to 5 years, of grain. Grain can be grown for several consecutive years without risk of excessive erosion if all crop residue is returned to the soil, all tillage is done across the slope or on the contour, waterways are shaped and seeded to grass, and fall grain is seeded early. Chiseling in fall is needed every few years to shatter tillage pans and to reduce the risk of erosion. The Hodgson soil in this unit is subject to heaving during periods of freezing and thawing.

These soils would be suitable for irrigation if water were available.

CAPABILITY UNIT IVe-1 NONIRRIGATED

The soils in this unit are well drained and somewhat excessively drained. Permeability ranges from moderately slow to rapid, but is dominantly moderately slow or moderate. The available water capacity ranges from low to high, but is dominantly moderate to high. Slopes range from 0 to 25 percent. Runoff is very slow to medium, and the erosion hazard is slight or moderate. The annual precipitation is 14 to 20 inches. The frost-free season is 90 to 135 days.

Small grain, legumes, and grass are the main crops. The small grain is ordinarily spring wheat. Fall-planted wheat is commonly subject to mold. Alfalfa is the chief legume. Intermediate wheatgrass is suitable for reseeding old crop fields to pasture and hay. A small amount of alfalfa is usually seeded with the wheatgrass.

On some acreages spring wheat is rotated with summer fallow. The straw is cut and baled. This rotation does not check erosion during spring runoff, nor does it maintain the supply of organic matter needed for good tilth. Erosion can be controlled if the soil is worked no more than is necessary to control weeds and prepare a seedbed, all crop residue is turned under, and grasses and legumes are rotated with small grain. Drop structures may be needed to slow runoff in waterways. Smooth bromegrass is suitable for seeding waterways.

CAPABILITY UNIT IVe-2 NONIRRIGATED

The soils in this unit are well drained and moderately well drained. Permeability is moderate or moderately slow. The available water capacity is low to high. Slopes range from 0 to 30 percent. Runoff is very slow to rapid, and the erosion hazard is slight to severe. The annual precipitation is 14 to 35 inches. The frost-free period is 80 to 130 days.

These soils are used mainly for grazing. Some were cleared of trees by homesteaders and planted to grain. Many that were cleared, however, have reverted to native pasture and trees.

A dominantly grass cropping system is typical on the soils in this unit. When the grass becomes unproductive, small grain is grown for a year to break down the sod and then grass is reseeded. Intermediate wheatgrass is excellent for reseeding. Alfalfa is usually sown with the grass. Oats and barley are the chief grains. Crop residue is turned under, and all plowing is done on the contour or across the slope. Weeds can be controlled by chemical sprays and by maintaining at least 4 inches of growth on pasture plants.

CAPABILITY UNIT IVe-3 NONIRRIGATED

Cedonia silt loam, 15 to 35 percent slopes, the only soil in this unit, is well drained and moderately permeable. The available water capacity is high. Runoff is medium or rapid, and the erosion hazard is moderate or severe. The annual precipitation is 18 to 21 inches. The frost-free season is 110 to 130 days.

This soil is used for grazing. In areas where slopes are less than 25 percent, it is suited to a rotation of small grain and perennial sod. A suitable rotation is 5 to 10 years of alfalfa and orchardgrass followed by 3 to 5 years of wheat. All tillage should be done across the slope or on the contour, waterways should be seeded to grass, all crop residue should be mixed with the soil, and fall grain should be seeded early in a rough, cloddy seedbed.

CAPABILITY UNIT IVw-1 NONIRRIGATED

The soils in this unit are somewhat poorly drained and poorly drained. Permeability is moderate to slow. The water table is at or near the surface early in spring, but is below a depth of 3 feet by the middle of June. The available water capacity is high. Slopes are 0 to 3 percent. Runoff is very slow, and the erosion hazard is slight. The annual precipitation is 14 to 19 inches. The frost-free season is about 90 to 120 days.

These soils are used for grass and legumes. If drainage is improved, small grain can be grown. In some areas artificial drainage is not possible because outlets are not available. Under natural conditions all the soils provide excellent pasture and habitat for waterfowl. Timothy, reed canarygrass, and meadow foxtail are the main hay and pasture plants. Spring wheat and barley are the main grains on the somewhat poorly drained soils.

In areas of improved drainage, a suitable cropping system is 5 to 10 years of legumes and grass followed by 1 or 2 years of grain. It is best to prepare a seedbed when the moisture content is low enough for the soil to crumble easily. Mowing and controlled grazing reduce weed competition. As a rule, grass is grazed until it is about 2 inches high; then grazing is discontinued to allow regrowth.

CAPABILITY UNIT IVs-1 NONIRRIGATED

In this unit are well-drained and somewhat excessively drained soils that are only 14 to 35 inches deep over loose gravelly sand. Permeability is moderate to rapid. The available water capacity is low. Slopes are 0 to 3 percent. Runoff is very slow, and there is little or no hazard of erosion. The annual precipitation is 14 to 17 inches. The frost-free season is about 100 to 130 days.

Alfalfa, grass, and small grain are the chief crops. Alfalfa and grass are better suited than grain. Winter wheat is commonly smothered under packed snow.

A typical cropping system is 5 to 10 years of grass and legumes followed by 1 or 2 years of grain. A granular soil structure can be maintained if all crop residue is returned to the soil and the soil is tilled only three or four times during seedbed preparation. Intermediate wheatgrass and alfalfa are good soil-improving crops. Soil moisture can be used most efficiently if weeds are controlled and the seeding rate is adjusted to the limited amount of available water. Rodents, mainly pocket gophers, can be controlled if treated grain is placed in their runways.

These soils would be suitable for irrigation if water were available.

CAPABILITY UNIT IVs-2 NONIRRIGATED

In this unit are well-drained soils that are only 24 to 30 inches deep over gravelly sand. Permeability is moderate or moderately rapid. The available water capacity is low or moderate. Slopes are 0 to 5 percent. Runoff is slow or very slow, and there is little or no hazard of erosion. The annual precipitation is 14 to 30 inches, and the frost-free season is 90 to 120 days.

These soils are used for trees and grass. They are suited to spring wheat, barley, and oats and to alfalfa and grass for hay and pasture. Intermediate wheatgrass and alfalfa are the main hay and pasture plants. All the acreage cleared of trees is now in native or seeded pasture.

A typical cropping system is 1 or 2 years, or possibly 3 to 5 years, of grain followed by 5 to 10 years of perennial sod. All crop residue is returned to the soil. Controlling weeds and seeding at an appropriate rate conserves soil moisture.

CAPABILITY UNIT IVs-3 NONIRRIGATED

The soils in this unit are somewhat excessively drained. Permeability is moderately rapid or rapid. The available water capacity is low or moderate. Slopes range from 0 to 25 percent. Runoff is very slow or slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate on the Bisbee soil in this unit. The annual precipitation is 14 to 21 inches. The frost-free season is 100 to 130 days.

These soils are used for grass, legumes, and small grain. A typical cropping system is 5 to 10 years of alfalfa and grass for hay and pasture followed by 1 or 2 years of grain. The soils are better suited to fallplanted wheat than to spring wheat. Spring wheat does not provide sufficient straw for control of soil blowing. Returning all crop residue to the soil and seeding fall grain early help in controlling erosion.

CAPABILITY UNIT Vw-1 NONIRRIGATED

This unit consists only of organic soils, Peat and Muck. Peat and Muck is in depressions, is very poorly drained, and is ponded most of the year.

CAPABLITY UNIT VIe-1 NONIRRIGATED

The soils in this unit are well drained. Permeability is moderately slow to moderately rapid. The available water capacity is low to high. Slopes range from 0 to 45 percent. Runoff is slow to rapid, and the erosion hazard is slight to severe. The annual precipitation is 14 to 20 inches. The frost-free season is 90 to 135 days.

Most of the acreage is in grass. Slopes of less than 30 percent were used for small grain by early settlers. All but a few acres are now in native or seeded pasture. Intermediate wheatgrass is suitable for reseeding. Excess stones limit the use of equipment on part of the acreage.

CAPABILITY UNIT VIe-2 NONIRRIGATED

The soils in this unit are well drained and somewhat excessively drained. Permeability is moderately slow to rapid. The available water capacity is very low to moderately high. Slopes range from 0 to 65 percent. Runoff is slow to very rapid. The hazard of erosion is slight to very severe. The annual precipitation is 14 to 35 inches. The frost-free season is 80 to 130 days.

The erosion hazard, the stones, and the steep slopes make these soils better suited to trees than to pasture or tilled crops.

CAPABILITY UNIT VIe-3 NONIRRIGATED

The soils in this unit are moderately well drained to somewhat excessively drained. Permeability is moderately slow to rapid. The available water capacity is very low to high. Slopes range from 0 to 45 percent. Runoff is very slow to rapid, and the erosion hazard is slight to severe. The annual precipitation is 14 to 21 inches. The frost-free period is 100 to 130 days.

These soils are used for grass and trees and are not suitable for cultivation. The productivity of wood crops can be increased and grazing improved if the forest is thinned out and the trees are pruned.

CAPABILITY UNIT VIs-1 NONIRRIGATED

The soils in this unit are well drained and somewhat excessively drained. Permeability is moderate to rapid. The available -water capacity is very low or low. Slopes range from 0 to 45 percent. Runoff is slow to rapid. The water erosion hazard is slight to severe. The hazard of soil blowing is moderate on the Bisbee soil in this unit. The annual precipitation is 14 to 21 inches. The frost-free season is 90 to 130 days.

These soils are used for grass and alfalfa. They are generally not suitable for cultivation. Small grain, however, is grown on some acreages. The soils are suited to crested or Siberian wheatgrass. Excess stones limit the use of equipment on part of the acreage.

CAPABILITY UNIT VIIe-1 NONIRRIGATED

The soils in this unit are moderately well drained to somewhat excessively drained. Permeability is moderately slow to moderately rapid. The available water capacity is low to high. Slopes range from 25 to 65 percent. Runoff is rapid or very rapid, and the erosion hazard is severe or very severe. The annual precipitation is 14 to 30 inches. The frost-free season is 90 to 130 days.

The cobbles and stones, the sandy texture, and the steep or very steep slopes limit the use of these soils to trees, grazing, recreation, and wildlife.

CAPABILITY UNIT VIIs-1 NONIRRIGATED

This unit consists of rock outcrop and mostly gravelly, stony, and extremely stony soils. Most of the soils are moderately permeable. Some are rapidly permeable. The available water capacity is very low to moderately high. Slopes range from 15 to 65 percent. Runoff is medium to very rapid, and the erosion hazard is moderate to very severe. The annual precipitation is 14 to 35 inches. The frost-free season is 70 to 135 days.

These soils provide grazing and wildlife habitat.

CAPABILITY UNIT VIIIw-1 NONIRRIGATED

This unit consists only of areas that are covered with water most of the year or are subject to flooding every spring. These areas are useful only as habitat for wildlife.

CAPABILITY UNIT VIIIs-1 NONIRRIGATED

This unit consist of areas that are rocky, stony, cobbly, or gravelly. These areas are suitable only for wildlife, watershed, and recreation.

Management o f irrigated soils

About 3,000 acres of the North Ferry Area is irrigated. Most of the irrigation water is taken from perennial streams. A small amount is obtained from wells. All of it is applied by sprinklers. The potential for additional irrigation is limited by the lack of sufficient water. Only the management of soils now irrigated is considered in the paragraphs that follow.

CAPABILITY UNIT IIIe-1 IRRIGATED

The soils in this unit are well drained and somewhat excessively drained. Permeability is moderately slow to rapid. The available water capacity is low to high. Slopes range from 0 to 15 percent. Runoff is very slow to medium, and the erosion hazard is slight or moderate. The annual precipitation is 14 to 20 inches. The frost-free season is 95 to 130 days.

The short growing season restricts the variety of crops that can be grown. Small grain, grass, and legumes are suitable crops. Spring wheat and barley are the main grains. Alfalfa and orchardgrass are the chief legume and grass plants.

A typical cropping system is 6 to 10 years of grass and legumes in rotation with 1 or 2 years of grain. The risk of erosion can be reduced if all crop residue is left in the field, waterways are seeded to grass, and the soil is left rough and cloddy throughout the winter.

These soils are suitable for sprinkler irrigation. Water can be conserved if the proper amount is applied as needed and weeds are controlled by mowing or by chemical sprays.

CAPABILITY UNIT IIIe-2 IRRIGATED

The soils in this unit are moderately well drained. Permeability is moderately slow. The available water capacity is high. Slopes are mostly 3 to 15 percent, but range from 0 to 15 percent. Runoff is very slow to medium, and the erosion hazard is slight or moderate. The annual precipitation is 18 to 21 inches, and the frost-free season is 110 to 130 days.

These soils are suited to wheat, barley, oats, grass, and legumes. They are used for small grain and grass and for alfalfa for hay and pasture.

Controlling erosion and improving tilth are important if the soil is cropped to grain. The risk of erosion can be reduced if waterways are shaped and seeded to grass, all crop residue is returned to the soil, and all tillage is done across the slope. Grass and legumes in the cropping system also help in controlling erosion and in improving tilth or maintaining good tilth. A common rotation is 2 to 4 years of alfalfa and orchardgrass followed by 4 or more years of wheat or barley. In some fields chiseling is needed every few years to shatter tillage pans. It is best to shatter the pans when the soil is dry.

These soils are suitable for sprinkler irrigation.

CAPABILITY UNIT IIIe-3 IRRIGATED

The soils in this unit are well drained. Permeability is moderate. The available water capacity is high. Slopes range from 0 to 8 percent. Runoff is very slow or slow, and the erosion hazard is slight. The annual precipitation is 14 to 21 inches. The frost-free season is 100 to 130 days.

These soils are suited to wheat, barley, oats, potatoes, grass, and alfalfa. They are used mainly for grain, hay, and pasture.

A typical cropping system is 2 to 4 years of grass or grass and alfalfa and 4 or more years of grain. Row crops can be grown without the risk of excessive erosion if all crop residue is returned to the soil and waterways are seeded to grass. Soil bare of vegetation should be left rough and cloddy during winter. Grass and legumes in the cropping system help in controlling

erosion and improving tilth. In some fields chiseling is needed every few years to shatter tillage pans.

These soils are suitable for sprinkler irrigation. Excessive runoff can be avoided if the irrigation system is designed for the proper intake rate and adjusted to the amount of water available.

CAPABILITY UNIT IIIs-1 IRRIGATED

In this unit are well-drained and somewhat excessively drained soils that are only about 24 inches deep over very gravelly sand. Permeability is moderate or rapid. The available water capacity is low or moderate. Slopes are 0 to 3 percent. Runoff is very slow. There is little or no hazard of erosion. The annual precipitation is 14 to 17 inches. The frost-free season is about 90 to 130 days.

These soils are suited to wheat, barley, oats, grass, and legumes. They are used mainly for grain and for alfalfa and grass for hay and pasture.

A suitable cropping system is one in which all crop residue is returned to the soil and grain is cropped in rotation with grass or grass and alfalfa. A common rotation is 5 to 10 years of orchardgrass or orchardgrass and alfalfa followed by 1 or 2 years of wheat or barley.

These soils are suitable for sprinkler irrigation. Frequent applications of water for short periods and split applications of fertilizer slow down the leaching of nutrients.

CAPABILITY UNIT IVs-1 IRRIGATED

In this unit are somewhat excessively drained soils that are shallow over sand or gravelly sand. Permeability is moderately rapid or rapid. The available water capacity is very low to moderate. Slopes range from 0 to 25 percent. Runoff is mostly very slow, and the hazard of erosion is mostly slight. On the strongly sloping Springdale soil in this unit, however, runoff is medium and the erosion hazard moderate. The annual precipitation is 14 to 21 inches. The frost-free season is 100 to 130 days.

These soils are suited to wheat, barley, oats, grass, and alfalfa. The Bisbee and Dart soils in this unit are suited to orchards. The low areas of the Malo soil in this unit are occasionally flooded and should be seeded to permanent grass.

A suitable cropping system is 5 to 10 years of grass or grass and alfalfa followed by 1 or 2 years of grain. All residue should be returned to the soil.

These soils are suitable for sprinkler irrigation. Frequent applications of water for short periods slow down the leaching of nutrients.

Estimated Yields

Estimates of yields in this survey are based mostly on information furnished by farmers and ranchers in the area. Some estimates, however, are based on the observations of the soil scientists who surveyed the area and on those of State and Federal farm advisors familiar with the soils and crops of the North Ferry Area.

The estimates are averages for a period of years. In a given year the yield of any crop can be more or less than the figure shown. Rain late in May and early in June generally results in high yields. On the other hand, lack of rain in May or June results in yields much below the average. Past and present management, crop varieties, and other factors also affect yields.

Table 2 shows the estimated yields of the chief crops grown. Except for alfalfa and grass, the crops listed are nonirrigated. A few areas, mostly along Curlew Creek and the Kettle River, are irrigated by sprinklers.

Yields listed in table 2 are those obtained under improved management. Under this level of management, fertilizer rates are determined by soil tests and by the amount of soil moisture expected to be available to the crop. Alfalfa is fertilized with phosphorus and with boron and sulfur if needed. Small grain is fertilized with nitrogen and with sulfur in spring if needed. After hay removal in July, alfalfa is generally not grazed. If it is grazed, the grazing is restricted. The soil is tilled by chiseling across the slope in fall and disking in spring. Additional tillage is limited to seeding the crop and controlling weeds. The time of seeding is around May 10.

Under improved management in irrigated areas, water is managed efficiently to avoid leaching of fertilizer, fertilizer is applied according to the results of soil tests, the proper alfalfa-grass balance is maintained, and weeds are controlled.

Range

About 18 percent, or 143,000 acres, of the survey area is range. Exposures are mostly to the south and west, and elevations are 1,700 to 6,500 feet.

In order to manage range properly, the operator must recognize the different kinds of soil on his range and the present and potential plant community each soil is capable of growing. Soils that have the capacity to produce the same kinds, amounts, and proportions of range plants are grouped into range sites.

A range site is a distinctive kind of range that differs from other kinds in its potential to produce a characteristic natural plant community. It is the product of all environmental factors-the soil, the climate, and the vegetation.

The potential, or climax, vegetation on a range site is the native plant community best adapted to the particular environment. This plant community is stable and is in equilibrium with the environment.

Abnormal disturbance, such as overuse by livestock or excessive burning or plowing, results in changes in the climax plant community, or even complete destruction if the disturbance is drastic enough. Unless the range site deteriorates significantly under such disturbance, including water erosion and soil blowing, the succeeding plant cover is near the natural potential, or climax, plant community for the site.

Range conservationists and soil scientists determine the natural potential plant communities for individual soil units and group the soils into range sites.

Range condition is the present state of the vegetation, or plant community, on a range site as related to the climax plant community for the site. The chief purpose for determining range condition is to provide an index of the changes that have taken place in the plant

HARMON S. HODGKINSON, range conservationist, Soil Conservation Service, helped prepare this section.

In the original manuscript, there was a table in this space.
All tables have been updated and are available from http://soildatamart.nrcs.usda.gov.

cover. If the potential plant community on a site is known, the present condition can be determined and thereby provide a basis for predicting changes in the plant community to be expected under specified management.

If changes in the climax plant community are the result of particular kinds of use or disturbance, some plant species increase and others decrease. How a plant reacts to grazing depends on the kind of grazing animal, the season of use, and the degree to which plant tissue is removed. By comparing the composition of the present condition to the climax plant community, it is possible to see how some plant species have increased and others have decreased. Plants that are not part of

the climax community but are evident in the present plant cover are called "invaders."

The potential and present composition of the plant community along with other range site information provides a basis for selecting management objectives, designing grazing systems, managing for wildlife, determining recreation potential, and evaluating hydrologic conditions.

Management objectives on range relate to increasing desirable plants and restoring the site to as near climax condition as is feasible. Sometimes, in order to meet specific needs in the grazing program or to provide wildlife habitat or other benefits, a plant community somewhat removed from the climax is created and maintained. The chief objective is to provide a plant community that protects and improves the soil and water resources and at the same time meets the needs of the operator.

The following paragraphs describe the range sites of the North Ferry Area, identify the major climax plants and chief invaders on the sites, and indicate the estimated potential total annual yield of air-dry forage on a site in excellent condition. The soils in each site can be determined by referring to the "Guide to Mapping Units" at the back of this survey.

BENCHLAND SITE

This is a well-drained to excessively drained site on terraces and eskers. It is dominantly nearly level to gently sloping. South-facing slopes are steep or very steep. Slopes range from 0 to 65 percent. The elevation ranges from 1,800 to 3,500 feet. The annual precipitation is 14 to 17 inches. Precipitation is highest in winter and spring. Summers are hot and dry, and storms are likely. Most of the native plant growth is between May 1 and June 30.

This site is approximately 14,700 acres.

Following is the approximate percent composition, by weight, of species in the climax plant community:

	Percent
Bluebunch wheatgrass	50
Sandberg bluegrass, needleandthread, threadleaf sedge	20
Idaho fescue, rough fescue	15
Lupine, pussytoes	5
Indian-wheat, biscuitroot	5
Buckwheat, cinquefoil	5

Bluebunch wheatgrass, Idaho fescue, and rough fescue decrease when the range is subjected to continuous heavy use, and less desirable plants, such as needleandthread, Sandberg bluegrass, needlegrass, lupine, yarrow, and cinquefoil, increase. Continued heavy use results in the invasion of weedy plants, such as cheatgrass, mustard, mullein, china lettuce, and diffuse knapweed.

If the site is in excellent condition, the total annual yield is 900 to 1,500 pounds per acre.

Reseeding is feasible in level and gently sloping areas. If desirable species are so scarce that the site cannot be improved by ordinary management, a seedbed should be prepared and the seeds drilled.

LOAMY SITE

This site has a southerly exposure. The soils are well drained and nearly level to very steep. Slopes range from 0 to 65 percent. The elevation is most commonly 2,000 to 4,000 feet, but ranges from 1,700 to 6,500 feet. The annual precipitation ranges from 14 to 35 inches. Precipitation is highest in winter and spring. Summers are warm and dry, and storms are likely. The most favorable conditions for most native plant growth are between May 20 and August 1.

This site is approximately 78,000 acres.

Following is the approximate percent composition, by weight, of species in the climax plant community:

	Percent
Bluebunch wheatgrass, Idaho fescue	55
Rough fescue, prairie junegrass	20
Sandberg bluegrass, pinegrass	10
Lupine, Penstemon, strawberry	6
Balsamroot, buckwheat, cinquefoil	6
Snowberry, ninebark, rose	3

Bluebunch wheatgrass, Idaho fescue, and rough fescue decrease when the range is subjected to continuous heavy use, and less desirable plants, such as Columbia needlegrass, Kentucky bluegrass, lupine, cinquefoil, yarrow, Balsamroot, snowberry, and ninebark, increase. Continued heavy use results in the invasion of weedy plants, such as cheatgrass, mustard, thistle, salsify, goldenrod, and knapweed.

If the site is in excellent condition, the total annual yield is 1,000 to 2,000 pounds per acre.

Reseeding is feasible in the more gently sloping areas. If desirable species are so scarce that the site cannot be improved by ordinary management, a seedbed should be prepared and the seeds drilled. If revegetation is needed in areas too stony or rocky for equipment, the soil can be seeded by broadcasting.

SHALLOW SITE

This site is on mountainsides and ridges. In many places it is 40 to 60 percent Rock land. The soils are well drained and moderately steep to very steep. Slopes range from 15 to 65 percent. The elevation ranges from 2,500 to 5,000 feet. The annual precipitation ranges from 15 to 25 inches. Precipitation is highest in winter and spring. Summers are hot and dry, and storms are likely. The most favorable conditions for native plant growth are between May 10 and July 15.

This site is approximately 50,300 acres.

Following is the approximate percent composition, by weight, of species in the climax plant community

	Percent
Bluebunch wheatgrass	55
Idaho fescue	10
Prairie junegrass, Sandberg bluegrass, Danthonia	10
Fleabane, buckwheat, lupine	10
Balsamroot, biscuitroot, pussytoes	10
Snowberry, ninebark, shrubby buckwheat	5

Bluebunch wheatgrass and Idaho fescue decrease when the range is subjected to continuous heavy use, and less desirable plants, such as prairie junegrass, Sandberg bluegrass, lupine, Balsamroot, yarrow, and fleabane, increase. Continued heavy use results in the invasion of weedy plants, such as cheatgrass, mullein, mustard, and diffuse knapweed.

If the site is in excellent condition, the total annual yield is 500 to 1,100 pounds per acre.

Reseeding is not feasible because the soils are less than 20 inches deep over bedrock, rock crops out, and the terrain is steep.

Wildlife

The soils, the topography, the climate, the wide variety of vegetation, and other features combine to favor the development of wildlife habitat in the North Ferry Area. These features also provide a high potential for increasing and maintaining various kinds of wildlife. The chief kinds of native game are white-tailed deer, mule deer, black bear, spruce grouse, ruffed grouse, and blue grouse. Bighorn sheep and wild turkey have been introduced into the area. Also evident are such fur bearers as beaver, racoon, skunk, and mink; such predators as mountain lion, coyote, and bobcat; and numerous species of nongame birds.

Most ponds and lakes are stocked with trout, and the Kettle River, Sherman Creek, Curlew Creek, and the San Poil River afford good to excellent fishing opportunities. Ducks and geese use the lakes and the streams during migration.

Income from leasing for recreational hunting is becoming increasingly important in the area.

Successful management of wildlife on any tract of land requires, among other things, that food, cover, and water be available in a suitable combination. If any one of these necessities is missing or poorly distributed, desirable wildlife species cannot survive in significant numbers. Information about soils is important in creating, improving, or maintaining suitable food, cover, and water for wildlife.

Wildlife habitat is managed mainly by planting suitable vegetation; by manipulating existing vegetation so as to establish, increase, or improve desirable plants ; or by a combination of these measures. The influence of soil on the growth of plants is known for many plants. It can be predicted for other plants from knowledge of the characteristics and behavior of the soil. In addition, information about soils is useful in creating or improving water areas for wildlife.

Soil interpretations for wildlife habitat serve a variety of purposes. They are an aid in selecting the more suitable areas for various kinds of management. They indicate the intensity of management needed to achieve satisfactory results. They also serve as a means of showing why it is not feasible to manage a particular area for a given kind of wildlife.

The areas shown on the soil survey maps are rated for the kinds of soil and not for the influence of adjoining areas. Some influences on habitat, such as elevation, aspect, and exposure, must be determined at the site.

Soils directly influence the kind and amount of vegetation and the amount of available water and therefore indirectly influence the species of wildlife that can live in an area.

In table 3 soils of this survey area are rated for seven elements of wildlife habitat and four kinds of wildlife. The ratings indicate suitability for various habitat elements. A rating of *good* means that the habitat is easily improved, maintained, or created. There are few or no soil limitations in habitat management, and satisfactory results can be expected. A rating of *fair* means that the habitat can be improved, maintained, or created, but moderate soil limitations affect habitat management or development. A moderate intensity of management and fairly frequent attention may be required to ensure satisfactory results. A rating of *poor* means that the habitat can be improved, maintained, or created, but the soil limitations are severe. Habitat management may be difficult and expensive and may require intensive effort. Satisfactory results are unlikely. A rating of *very poor* means that it is impracticable to improve, maintain, or create habitat. Unsatisfactory results are probable.

The elements of wildlife habitat and the kinds of wildlife are defined in the following paragraphs.

HABITAT ELEMENTS.-Each soil is rated in table 3 according to its suitability for producing various kinds of plants and other elements that make up a wildlife habitat. The ratings take into account mainly the characteristics of the soils and closely related environmental factors. They do not take into account present use of soils or present distribution of wildlife and people. For this reason, selection of a site for development of a habitat for wildlife requires inspection at the site.

Grain and seed crops are annual grain-producing plants, such as wheat, barley, and oats.

Domestic grasses and legumes, which are established by planting, provide food and cover for wildlife. Examples of grasses are intermediate wheatgrass, pubescent wheatgrass, Whitmar wheatgrass, crested wheatgrass, meadow boxtail, and reed canarygrass. Examples of legumes are White Dutch clover, sweetclover, alsike clover, and alfalfa.

Wild herbaceous plants are native or introduced perennial grasses, forbs, and weeds that provide food and cover for many wildlife species. Examples are lupine, Balsamroot, biscuitroot, cheatgrass, bluebunch wheatgrass, mountain brome, Idaho fescue, Canadian wildrye, rough fescue, and lotus.

Coniferous plants are cone-bearing trees and shrubs that provide cover and commonly furnish food in the form of browse, seeds, or cones. They commonly grow in their natural environment, but can be planted and managed. Typical plants are pine, Douglas-fir, grand fir, subalpine fir, larch, cedar, prostrate juniper, and spruce.

Shrubs produce buds, twigs, bark, or foilage used as food by wildlife. They provide cover and shade for some wildlife species. They grow mostly in their natural environment. Typical plants are Oregongrape, rabbitbrush, bitterbrush, ninebark, snowberry, ceanothus, huckleberry, serviceberry, chokecherry, and dogwood.

Wetland plants are annual and perennial herbaceous plants that grow wild on moist and wet sites. They furnish food and cover mostly for wetland wildlife. Typical examples are smartweed, wild millet, cattail, rushes, sedge, watercress, burseed, and tearthumb. Submerged and floating plants are not included in this category

Shallow water areas are areas of surface water that have an average depth of less than 5 feet and are useful to wildlife. They can be natural wet areas or those created by dams or by water-control devices in marshes or streams. Typical examples are waterfowlfeeding areas, wildlife-watering developments, wildlife ponds, and beaver ponds.

By LEROY A. SHEARER, biologist, Soil Conservation Service, Spokane, Washington.

KINDS OF WILDLIFE-Table 3 rates soils according to their suitability as habitat for the four kinds of wildlife in the area-openland, woodland, wetland, and rangeland wildlife. These ratings are related to ratings for the elements of habitat. For example, soils rated as very poor for shallow water developments are rated very poor for wetland wildlife.

Openland wildlife are birds and mammals of crop fields, pastures, meadows, lawns, and areas overgrown with grasses, herbs, shrubs, and vines. Examples are field sparrow, ground squirrels, and marmots.

Woodland wildlife are birds and mammals of wooded areas where there are coniferous trees and shrubs. Examples are wild turkey, blue and ruffed grouse, thrush, woodpecker, squirrel, raccoon, white-tailed deer, and black bear.

Wetland wildlife are birds and mammals of swampy, marshy, or open-water areas. Examples are ducks, geese, herons, shore birds, rails, kingfishers, muskrat, mink, and beaver.

Rangeland wildlife are birds and mammals of natural rangelands. Examples are white-tailed deer, mule deer, meadowlark, and lark bunting.

Woodland

In the past, the production of wood products was the chief use of forest land. Much of the privately owned land, however, was managed as timbered range.

At the present time, uses other than the production of wood products are influencing the management of forest land. Hunting, fishing, camping, and other recreational activities are markedly affecting the management of public land. Investors in land for recreation and others are causing a sharp increase in the price of private land.

This change in the use of forest land, together with changes in the market, has also affected the wood-processing plants. There is now only one lumber mill processing between 40,000 and 80,000 board feet per 8-hour shift. There are only five small lumber mills that process about 40,000 board feet per 8-hour shift. There are no pulp or plywood mills in the area at present.

Disease and insects vary in their effect on trees in the area. Dwarf mistletoe is common on larch and Douglas-fir and to a lesser extent on ponderosa pine. The casebearer insect considerably inhibits the growth of western larch, but is not causing widespread mortality.

Various types of woodland are in the North Ferry Area. The lower valleys, which are commonly in areas of private land where the timbered range is grazed by livestock, support stands of ponderosa pine and cottonwood and an understory of bunchgrass. As the elevation increases, the benches, terraces, and foot slopes, all of which are in areas of mixed public and private land, support mixed stands of ponderosa pine and Douglas-fir and aspect, or direction of slope, influences the composition of the forest stand. Ponderosa pine is common on the south- and west-facing slopes. Douglas fir is common on the north- and east-facing slopes. Where the available water capacity is higher and the spring frosts are more severe, lodgepole pine and larch are common. At the higher elevations, where most of the lands are publicly owned, Douglas-fir, larch, and lodgepole pine are common and cedar, Engelmann spruce, grand fir, and scattered subalpine fir are on the high valley floors.

Aspen occurs in small stands or clumps throughout the area.

Tables 4, 5, and 6 show the results of woodland interpretations of the soils in the North Ferry Area. Interpretations on private land were made from plots and onsite observation. Interpretations on National Forest land were made from inventory information, onsite observation, and soil interpretations, mostly from a 1969 inservice publication "Soils Report for Republic and Kettle Falls Ranger Districts," Colville National Forest, Washington. Some adjustment of the site class was needed. Unpublished local site curves - were used in the above report, and published regional site curves were used to determine productivity on private land (2, 6).

Table 4 shows the productivity, the management concerns, and the plant associations on the soils in the area.

Following are explanations of some of the columns in table 4.

The acreage is indicated as dominantly private land or National Forest land.

Woodland subclass is identified by a two-part symbol, for example, 5s. The first part, a numeral, indicates the productivity of the soil. The numeral 1 means very high; 2, high; 3, moderately high; 4, moderate; and 5, low.

The second part of the symbol, a letter, indicates hazards or limitations in managing the soils for wood crops. The letter d shows that root depth is restricted by a compacted layer or bedrock. The letter f shows that the main limitation is the excessive number of rock fragments and the resulting droughty soils. The letter a means that the soil has few limitations restricting its use for trees. The letter r, used if slope is 30 percent or more, shows steep or very steep soil that is subject to moderate or severe erosion. In areas where the soil has this rating, the use of equipment is somewhat limited. The letter s means sandy soil where there is little or no difference in texture between the surface layer and the subsoil, or B horizon. The letter w means that the soil is excessively wet seasonally or year round, has restricted drainage and a high water table, and is subject to flooding. The letter x indicates that woodland use or management is limited by stones or rocks.

Erosion hazard indicates the degree of potential erosion. *None* or *slight* means that the risk of erosion is not important. *Moderate* indicates that some attention is needed to prevent erosion. *Severe* means that erosion must be minimized by intensive treatment and specialized equipment and methods of operation.

Equipment limitations refers to those soil characteristics that restrict the use of harvesting equipment. *Slight* means no restrictions in the kind of equipment or time of year it is used; *moderate* means that use of equipment is restricted for 3 months of the year or

R. J. OLSON and L. L. LENZ, woodland conservationists, Soil Conservation Service, and RON HANSON, resource assistant, United States Department of Agriculture, Forest Service, helped prepare this section.

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less; and *severe* means that special equipment is needed and its use is restricted for more than 3 months of the year.

Seedling mortality refers to the expected degree of mortality of seedlings as influenced by kinds of soil or topography. Plant competition is not considered a factor. *Slight* means a loss of 0 to 25 percent; *moderate,* 25 to 50 percent; and *severe,* more than 50 percent.

Plant competition is the degree to which undesirable plants invade openings in the tree canopy. *Slight* means that plant competition does not prevent adequate natural regeneration and early growth or interfere with seedling development; *moderate* that it delays natural or artificial establishment or growth rate, but

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does not prevent the development of fully stocked normal stands; and *severe* that it prevents adequate natural or artificial regeneration unless the site is prepared properly and maintained by such practices as burning, spraying, disking, or girdling.

Potential productivity indicates important trees and woodland site classes. The site classes show potential productivity of soils for the important trees. Roman numeral I indicates very high productivity; II, high; III, moderately high; IV, moderate; and V, low.

Habitat types refers to plant associations, which are indicated by symbols and explained in a footnote at the end of the table (3).

Tables 5 and 6 show, respectively, representative yields by site class and representative average annual growth of unmanaged stands of ponderosa pine. Because several published and unpublished site curves were used to determine productivity, the tables should be used only as guides for determining production or growth rates.

Engineering

This section is useful to those who need information about soils used as structural material or as foundation upon which structures are built. Among those who can benefit from this section are planning commissions, town and *city* managers, land developers, engineers, contractors, and farmers.

Among properties of soils highly important in engineering are permeability, strength, compaction characteristics, soil drainage condition, shrink-swell potential, grain size, plasticity, and soil reaction. Also important are depth to the water table, depth to bedrock, and soil slope. These properties, in various degrees and combinations, affect construction and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

Information in this section can be helpful to those who

1. Select potential residential, industrial, commercial, and recreational areas.
2. Evaluate alternate routes for roads, highways, pipelines, and underground cables.
3. Seek sources of gravel, sand, or clay.
4. Plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil.
5. Correlate performance of structures already built with properties of the kinds of soil on which they are built, for the purpose of predicting performance of structures on the same or similar kinds of soil in other locations.
6. Predict the trafficability of soils for cross country movement of vehicles and construction equipment.
7. Develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in tables 7, 8, and 9, which show, respectively, estimates of soil properties significant in engineering; interpretations for various engineering uses ; and results of engineering laboratory tests on soil samples.

This information, along with the soil map and other

WILLIAM A. BENNETT, engineer, Soil Conservation Service, helped prepare this section.

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parts of this publication, can be used to make interpretations in addition to those given in tables 7 and 8, and it also can be used to make other useful maps.

This information, however, does not eliminate need for further investigations at sites selected for engineering works, especially works that involve heavy loads or that require excavations to depths greater than those shown in the tables, generally depths greater than 6 feet. Also, inspection of sites, especially the small ones, is needed because many delineated areas of a given soil mapping unit contain small areas of other kinds of soil that have strongly contrasting properties and different suitabilities or limitations for soil engineering.

Some terms used in this soil survey have special meanings in soil science that may not be familiar to engineers. The Glossary defines many of these terms.

Engineering soil classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system used by the SCS engineers, Department of Defense,

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and others and the AASHTO system adopted by the American Association of State Highway and Transportation Officials (1,7).

In the Unified system soils are classified according to particle-size distribution, plasticity, liquid limit, and organic matter. Soils are grouped in 15 classes. There are eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes are designated by symbols for both classes ; for example, SP-SM.

The AASHTO system is used to classify soils according to those properties that affect use in highway construction and maintenance. In this system, a soil is placed in one of seven basic groups ranging from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A-1 are gravelly soils, which have high bearing strength and are the best soils for foundation or subgrade. At the other extreme, in group A-7, are clay soils, which

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have low strength when wet and are the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A-1, A-2, and A-7 groups are divided as follows: A-1-a, A-1-b, A-2 4, A-2-5, A-2-7, A-7-5, and A-7-6. As additional refinement, the engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 for the best material to 20 or more for the poorest (1). The AASHTO classification for tested soils, with group index numbers in parentheses, is shown in table 9 ; the estimated classification, without group index numbers, is given in table 7 for all soils mapped in the survey area.

Soil properties significant in engineering

Estimates of soil properties significant in engineering are given in table 7. They are made for typical soil profiles, by layers sufficiently different to have different significance for soil engineering. The estimates are based on field observations made in the course of mapping, on test data for these and similar soils, and on experience with the same kinds of soil in other counties. Following are explanations of some of the columns in table 7.

Depth to bedrock is distance from the surface of the soil to the upper surface of the rock layer.

Depth to seasonal high water table is distance from the surface of the soil to the highest level that ground water reaches in the soil in most years.

Soil texture is described in table 7 in the standard terms used by the Department of Agriculture. These terms take into account percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, "gravelly loamy sand." "Sand," "silt," "clay," and some of the other terms used in USDA textural classification are defined in the Glossary of this soil survey.

Permeability is the quality that enables a soil to transmit water or air. It is estimated on the basis of those soil characteristics observed in the field, particularly structure, porosity, and texture. The estimates in table 7 do not take into account lateral seepage or such transient soil features as plowpans and surface crusts.

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Available water capacity is the ability of soils to hold water for use by most plants. It is commonly defined as the difference between the amount of water in the soil at field capacity and the amount at the wilting point of most crop plants.

Reaction is the degree of acidity or alkalinity of a soil, expressed in pH values. The pH value and terms used to describe soil reaction are explained in the Glossary.

Shrink-swell potential is the change in volume to be expected of soil material with changes in moisture content, that is, the extent to which the soil shrinks when dry or swells when wet. The extent of shrinking and swelling is influenced by the amount and kind of clay in the soil. Shrinking and swelling of soils cause much damage to building foundations, roads, and other structures. A *high* shrink-swell potential indicates a hazard to maintenance of structures built in, on, or with material having this rating.

Potential frost action is important in engineering, particularly in selecting sites for highways and runways and in planning any structure that is to be supported or abutted by soil that freezes. Unequal heaving can crack or tip concrete slabs or shallow footings and cause bumps or waves in flexible pavements. It causes driveways, patios, and sidewalks to lift and crack and disturbs the natural joints of structures. Thawing causes collapse of surface elevation and provides excess free water, which results in lower strength of the soil.

For frost action to occur, low temperatures must persist long enough to freeze water in the soil. The water can be from a high water table, or it can be capillary water, water held in voids, or water that infiltrates. Drainage that prevents the accumulation of water in soil pores helps to prevent the accumulation of ice in the subgrade and subbase.

Engineering interpretations of soils

The interpretations in table 8 are based on the estimated engineering properties shown in table 7, on test data for soils in this survey area and others nearby or adjoining, and on the experience of engineers and soil scientists with the soils of the North Ferry Area. Ratings in table 8 summarize the limitations of the soils for septic tank absorption fields, sewage lagoons, shallow excavations, dwellings with basements, sanitary landfill, and local roads and streets; summarize the *suit-*

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ability of the soils as sources of road fill, sand, gravel, and topsoil; and list those soil features not to be overlooked in planning, installing, and maintaining drainage of cropland and pasture, irrigation, ponds and reservoirs, embankments, and terraces and diversions.

Soil limitations are indicated by the ratings slight, moderate, and severe. *Slight* indicates soil properties generally favorable for the rated use, or in other words, limitations that are minor and easily overcome. *Moderate* means that some soil properties are unfavorable but can be overcome or modified by special planning and design. *Severe* indicates soil properties so unfavorable and so difficult to correct or overcome that major soil reclamation, special design, or intensive maintenance is required.

Soil suitability is rated by the terms *good, fair,* and *poor,* which have, respectively, meanings approximately parallel to the terms slight, moderate, and severe.

Following are explanations of some of the columns in table 8.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into natural soil. The soil material from a depth of 18 inches to 6 feet is evaluated. The soil properties considered are those that affect both absorption of effluent and construction and operation of the system. Properties that affect absorption are permeability, depth to water table or rock, and susceptibility to flooding. Slope is a soil property that affects difficulty of layout and construction and also the risk of soil erosion, lateral seepage, and downslope flow of effluent. Large rocks or boulders increase construction costs.

Sewage lagoons are shallow ponds constructed to hold sewage within a depth of 2 to 5 feet long enough for bacteria to decompose the solids. A lagoon has a nearly level floor and sides, or embankments, of compacted soil material. It is assumed that the embankment is compacted to medium density and the pond is protected from flooding. The properties considered are those that affect the pond floor and the embankment. Those that affect the pond floor are permeability, organic matter, and slope. If the floor needs to be leveled, depth to bedrock becomes important. The soil properties that affect the embankment are the engineering properties of the embankment material as interpreted from the Unified Soil Classification and the number of stones, if any, that influence the ease of excavation and compaction of the embankment material.

Shallow excavations are those that require digging or trenching to a depth of less than 6 feet, as for example, excavations for pipelines, sewer lines, phone and power transmission lines, basements, open ditches, and cemeteries. Desirable soil properties are good workability, moderate resistance to sloughing, gentle slopes, absence of rock outcrop or big stones, and freedom from flooding or a high water table.

Dwellings, as rated in table 8, are not more than three stories high and are supported by foundation footings in undisturbed soil. The features that affect the rating of a soil for dwellings are those that relate to capacity to support load and resist settlement under load and those that relate to ease of excavation. Soil properties that affect capacity to support load are wetness, frost action, susceptibility to flooding, density, plasticity, texture, and shrink-swell potential. Those that affect excavation are wetness, slope, depth to bedrock, and content of stones and rocks.

Sanitary landfill is a method of disposing of refuse

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in dug trenches. The waste is spread in thin layers, compacted, and covered with soil throughout the disposal period. Landfill areas are subject to heavy vehicular traffic. Some soil properties that affect suitability for landfill are ease of excavation, hazard of polluting ground water, and trafficability. The best soils have moderately slow permeability, withstand heavy traffic, and are friable and easy to excavate. Unless otherwise stated, the ratings in table 8 apply only to a depth of about 6 feet, and therefore limitation ratings of *slight* or *moderate* may not be valid if trenches are to be much deeper than that. For some soils, reliable predictions can be made to a depth of 10 or 15 feet, but every site should be investigated before it is selected.

Local roads and streets, as rated in table 8, have an all-weather surface expected to carry automobile traffic all year. They have a subgrade of underlying soil material; a base consisting of gravel, crushed rock, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. These roads are graded to shed water and have ordinary provisions for drainage. They are built mainly from soil at hand, and most cuts and fills are less than 6 feet deep.

Soil properties that most affect design and construction of roads and streets are the load-supporting capacity and stability of the subgrade and the workability and quantity of cut and fill material available. The AASHTO and Unified classifications of the soil material, and also the shrink-swell potential, indicate traffic-supporting capacity. Wetness and flooding affect stability of the material. Slope, depth to hard rock, content of stones and rocks, and wetness affect ease of excavation and amount of cut and fill needed to reach an even grade.

Road fill is soil material used in embankments for roads. The suitability ratings reflect (1) the predicted performance of soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage and (2) the ease of excavating the material at borrow areas.

Sand and gravel are used in great quantities in many kinds of construction. The ratings in table 8 provide guidance about where to look for probable sources. A soil rated as a *good* or *fair* source of sand or gravel generally has a layer at least 3 feet thick, the top of which is within a depth of 6 feet. The ratings do not take into account the location of the water table or other factors that affect mining the material, nor do they indicate quality of the deposit.

Topsoil is used for topdressing an area where vegetation is to be established and maintained. Suitability is affected mainly by the ease of working and spreading the soil material, for example, in preparing a seedbed; the natural fertility of the soil, or the response of plants when fertilizer is applied ; and the absence of substances toxic to plants. It is also affected by the texture of the soil material and the content of stone fragments. Also considered in the ratings is the damage that will result in the area from which topsoil is taken.

Pond reservoir areas hold water behind a dam or embankment. Soils suitable for this purpose have low seepage, which is related to permeability and depth to fractured or permeable bedrock or other permeable material.

Embankments, dikes, and levees require soil material resistant to seepage and piping and of favorable stability, shrink-swell potential, shear strength, and compactibility. The presence of stones or organic material in a soil is among unfavorable factors.

Test data

Table 9 gives engineering test data for soils from three major series in the North Ferry Area. These tests were made to help evaluate the soils for engineering purposes. The engineering classifications are based on data obtained by mechanical analyses and by tests to determine liquid limits and plastic limits. The mechanical analyses were made by combined sieve and hydrometer methods.

Tests to determine liquid limit and plastic limit measure the effect of water on the consistence of soil material. As the moisture content of a clayey soil is increased from a dry state, the material changes from a semisolid to a plastic state. If the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material changes from a semisolid to a plastic state ; and the liquid limit, from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is plastic. In table 9 the data on liquid limit and plasticity index are based on tests of soil samples.

Formation and Classification o f the Soils

This section explains the factors of soil formation, defines the system of soil classification, and classifies the soils of the North Ferry Area according to that system.

Factors of Soil Formation

Soil forms through the physical and chemical weathering of deposited or accumulated geologic material. The properties of the soil at any given place are determined by five factors : (1) the physical and mineralogical composition of the parent material ; (2) the climate under which the soil material has accumulated and existed since accumulation; (3) the plant and animal life on and in the soil; (4) the topography, or lay of the land; and (5) the length of time the forces of soil formation have acted on the soil material. The effect of these factors on the soils in the North Ferry Area is described in the following paragraphs.

Parent material

The soils of the North Ferry Area formed in material derived mainly from volcanic ash, glacial till, glacial outwash, lake sediment, weathered bedrock, recent alluvium, and organic matter.

The ash from volcanic eruptions in the Cascade Mountains was carried and deposited by postglacial winds over most of the North Ferry Area. Two eruptions, that of Glacier Peak about 12,000 years ago and that of Mount Mazama about 6,600 years ago, are considered the main sources of the ash (5).

Soils formed in volcanic ash and glacial till are the most common. They are on hills and mountainsides, but are typically more than 60 inches deep over bedrock. Below the soft ash mantle, the till is hard when dry but friable when moist. It ranges from sandy loam to loam or silt loam and from 15 to 40 percent gravel. Molson and Nevine soils are examples.

As the climate changed and the temperature became warmer, streams flowing from the melting ice moved the surface material and sorted it into sand, gravel, and other deposits. These deposits remain as terraces in the primary and secondary drainage channels in the area. Examples of these sorted deposits, known as glacial outwash, surround Curlew Lake. Around this lake, the tops of terraces are level to rolling and, in places, have deep depressions. These depressions resulted when outwash material formed around blocks of ice. As the ice melted, the material that rested on or against it collapsed. The glacial outwash is nearly free of clay or silt particles.

Soils formed in glacial outwash are about 20 to 30 inches deep over loose, coarse material. Below the soft ash mantle, the texture of the outwash is commonly loamy sand or coarse sand and the gravel content ranges from about 25 to 60 percent. Examples are Goddard, Mires, and Torboy soils.

Where drainageways were temporarily dammed by ice, glacial lakes formed. Nongravelly very fine sand, silt, and clay particles were deposited. In the Curlew area and along the Kettle River from Orient south to Lake Roosevelt, remnant lake sediment occurs on high terraces. In places this lake sediment is capped by ash.

Soils formed in glacial lake sediment are more than 60 inches deep over bedrock. The sediment ranges from very fine sandy loam or silt loam to silty clay and is stratified. Most of the soils are calcareous at lower depths. Examples are Anglen, Hodgson, and Hunters soils.

On ridges and peaks in the area, glacial till and volcanic ash material is thin or is not evident. The forces of climate have weathered the exposed bedrock in varying degrees. In the eastern part of the area, gneiss rock is only slightly weathered and only shallow soil has formed. In the western part, andesite rock is weathered enough that a shallow soil has formed. This soil, called Vallan soil, ranges from heavy loam to clay loam and from neutral to slightly acid and is 10 to 25 percent angular and rounded gravel and stones.

The churning of soil by animals and windthrown trees has exposed fragments of calcareous argillite. For this reason, Molcal soils are moderately alkaline and calcareous.

Recent alluvium is the main kind of parent material along streams and in basins. Carried from uplands, it is deposited during periods of overflow. The soils formed in this material are stratified, are variably deep over bedrock, are poorly drained to somewhat excessively drained, and are sandy to clayey. Mixed alluvial land and Malo and Ret soils are examples.

Organic soils are of minor extent. They formed in wet depressions where plants that thrive in water grow and decay in place. Peat and Muck is an example.

Ash is important in the soils of the area mainly in that it affects soil texture. For example, Bisbee soils, which lack any trace of this airborne material, are sandy. Molson and Nevine soils, which have a large amount of ash, are loamy.

During the Pleistocene epoch, which was prior to deposition of the ash, all of the North Ferry Area was

covered with ice and snow. The ice was a lobe of the Cordilleran icecap, the center of which was in British Columbia. The greatest thickness of this glacier was 6,700 feet (4). In the Kettle Range, some peaks, such as Sherman Peak and Copper Butte, are considered to have protruded above the ice as islands or nunataks. As the glacier moved southward in response to tremendous pressure from the icefield in British Columbia, existing residual soil and rock torn from ridges and peaks were mixed with material carried and ground by ice sheets. This material, known as glacial till, was deposited as the ice sheets melted. Little or none of it was transported by water. Glacial till is generally an unstratified, unconsolidated, heterogeneous mixture of clay, silt, sand, gravel, stones, and, in places, boulders. It is derived mainly from granite, andesite, gneiss, schist, argillite, and quartzite.

Living organisms

Plants, micro-organisms, earthworms, man, and other forms of life are important in determining the rate and character of soil formation. The most obvious effect of plants is the addition of organic matter, which darkens the color of the surface layer. In addition, plants provide protection against loss of water through runoff.

Different types of plants have different effects on soil formation. Grasses contribute a considerable quantity of organic material in the form of vegetation and roots, which remain on or in the soil. This material decomposes slowly and forms a thick, dark-colored A horizon. Trees deposit a large quantity of organic material in the form of needles and wood on the surface, where it is attacked by fungi and other soil organisms. Tree roots also contribute a significant amount of organic material. As a result, the amount of organic material in soil under trees is high by volume, but is generally not high enough to appreciably darken the surface layer.

Three broad vegetative associations occur in the North Ferry Area-grassland, grassland and woodland transition, and woodland.

Soils that formed under grass, for example, Hunters, Koepke, Mires, Molson, and Republic soils, have a dark-gray or dark grayish-brown A horizon that is 9 to 34 inches thick. The content of organic carbon is as much as 6 to 8 percent in the surface layer and the ratio of carbon to nitrogen is commonly about 15 to 1.

In some areas, forests have encroached on the grassland. Thick stands of Douglas-fir that have little or no understory are well established on some Molson and Koepke soils, but characteristics of soil formed under grass are dominant.

In other areas, soils formed under mixed grass and trees, for example, Cedonia, Donavan, and Goosmus soils, have apparently reached equilibrium with their environment. The A horizon in these soils is thinner and lighter colored than is typical of soil formed only under grass. It is 3 to 11 inches thick and is dark grayish brown or brown. The content of organic carbon ranges from 1 to 4 percent, and the ratio of carbon to nitrogen is about 19 to 1.

Soils formed under trees commonly have a very thin A2 horizon. Manley soils, which formed under Douglas-fir, larch, and spruce or subalpine fir, have a very thin, continuous, light-gray A2 horizon. Merkel and Nevine soils, which formed under Douglas-fir, larch, and scattered ponderosa pine, have no A2 horizon or have a very thin one that is light brownish gray. The content of organic carbon is about 1 to 3 percent at the surface, but decreases with increasing depth. The ratio of carbon to nitrogen is about 25 to 1.

Such animals as pocket gophers and ground squirrels affect the formation of soil under grass and, to a lesser extent, soil under trees. Pocket gophers dig an extensive network of tunnels and therefore mix the soil and carry organic material from the surface to lower depths. The filling of these tunnels in one horizon with material from another is conspicuous in Koepke, Molcal, Molson, and Stevens soils. In a Koepke soil, for example, the grass nest of a gopher was found at a depth of 3 feet.

Man has influenced the formation of soil. By clearing forests and planting crops, he has reversed the trend from the formation of a leached A2 horizon to the formation of a dark-colored Ap horizon. By clearing the soil of trees in an area along the Kettle River in sec. 15, T. 40 N., R. 32 E., he has contributed to the formation, within a period of 70 years, of a 4- to 6-inch Ap horizon. By cultivating on the steeper slopes, he has accelerated the rate of erosion.

Climate

Climate is one of the most important factors influencing soil formation in the North Ferry Area. Various climatic factors, such as the amount and seasonal distribution of precipitation, the temperature, the relative humidity, and the length of the frost-free season, largely determine the amount of water entering the soil and therefore determine the kind and amount of vegetation and the properties of the soils.

The climate of the North Ferry Area is continental. Winters are long and cold, and snow is usually on the ground from early in December until early in March. Cold air from the Arctic region enters the area through the valleys oriented in a north-south direction. The Rocky Mountains act as a natural barrier that prevents the severe storms of the Great Plains from entering the area. During the winter, warm air from the west produces much cloudiness and some fog.

Summers are sunny, hot, and dry. Air from over the continent brings high temperature and low relative humidity to the area. The eastward-moving cool air causes summer thunderstorms and brings periodic relief from the heat.

The amount of annual precipitation ranges from 12 to 18 inches in the lower valleys to 25 inches or more on the higher mountains. Precipitation is lowest in July and August. It increases gradually to a maximum in December, tapers off late in winter and in spring, and then increases again in June. During the winter, most of the precipitation is snow, and occasional periods of rain and warm wind occur at mid elevations and below.

The effect of summer rainfall is negligible. Storms are intense, but are of short duration. Only a little water percolates through the soil because low humidity and high temperature result in rapid evaporation. As a result, most soils are dry from the middle of July to late in October or perhaps to early in winter. During

this period, chemical and biological activity is slower than it would be under higher rainfall and humidity. Late in spring, moisture and temperature conditions favor the greatest biological activity.

In hot, dry areas the dominant vegetation is grass, and the soil accumulates organic matter in the surface layer and calcium carbonate in the lower horizons.

In cool, moist areas the dominant vegetation is trees. Acid from decomposing forest litter is carried downward through mineral soil layers, where it dissolves iron, aluminum, and carbonates, all of which are then translocated to lower layers. As a result, a very thin, light brownish-gray or light-gray leached layer forms over a light-brown layer of accumulated iron, humus, and aluminum. In Manley and Nevine soils, the depth to calcium carbonate is more than 60 inches.

In general, the greater the amount of moisture percolating through the soil, the more strongly leached the soil. The leaching is reflected not only in depth to lime or its complete removal, but also in the pH and base saturation of the soil. Hunters, Koepke, and Molson soils, which are in areas where the annual precipitation is 14 to 18 inches, range in pH from 6.8 to 8.2 and in base saturation from about 75 to 100 percent. In contrast, Manley and Nevine soils, which are in areas where the annual precipitation is 17 to 35 inches, range in pH from 6.0 to 7.2 and in base saturation from 45 to 80 percent.

Topography

Topography influences the soil-forming processes through its effect on runoff and drainage and its effect on microclimate.

The topography of the North Ferry Area is generally steep, but in places is nearly level to sloping. In level areas, runoff is slow and much of the water drains through the soil or evaporates. Where the slope is steeper, runoff increases and the amount of water entering the soil decreases. The more water that enters the soil, the greater the depth to which the soil is leached and weathered.

Topography influences the thickness of the surface layer in soils that formed from similar parent material. For example, Keopke soils, which are on northern exposures, foot slopes, and the concave slopes of other exposures, have an A horizon that is about 34 inches thick. In contrast, Molson soils, which are on convex slopes, have an A horizon that is about 18 inches thick. Also, they receive less effective moisture than Koepke soils.

Through its effect on drainage, topography affects the color of soils. The Ret variant, which is a poorly drained, nearly level soil in areas adjacent to the San Poil River, is dull in color and is distinctly mottled to a depth of 18 inches. The soil is usually saturated with water, but by early in August the water table is down to a depth of about 4 feet. In contrast, adjacent Ret soils, which are saturated with water for a shorter period, are brighter in color and have faint mottles that begin at depths below 30 inches.

Through variations in exposure to the sun and wind and in air drainage, topography creates differences in vegetation and soil properties that are noticable within short distances. For example, south-facing slopes receive more direct radiation from the sun than do north-facing slopes. Consequently, they are warmer and drier. Soil temperatures taken about the middle of each month at a depth of 20 inches for a period of 2 years have shown that the mean annual soil temperature on a northern exposure was 6° F cooler than the temperature on the opposite southern exposure.

An area between Heron and Lone Ranch Creeks illustrates the effect of exposure on soil formation. Molson soils, which formed under grass on warm and dry southern exposures, have a thick, dark-colored surface layer. Nevine soils, which formed under trees on the opposite northern exposures, have a lightcolored surface layer.

The effect of exposure is also evident at high elevations, where the climate is cool and moist. Conifers grow on both northern and southern exposures. In spring, snow remains on the northern exposures several weeks longer than on the southern exposures. The rate of evaporation is lower on the northern exposures, and as a result there is more effective soil moisture for the leaching of carbonates, iron, aluminum, and the dissolved products of organic litter. Manley soils, which are on northern exposures, have a strongly acid, leached surface layer and a bright-colored subsoil. Nevine soils, which are on the warmer, southern exposures, have a less acid, less strongly leached surface layer and a dull-colored subsoil.

Time

Time is necessary for the formation of soil from parent material. With increase in time, such soil characteristics as horizon differentiation and accumulation of iron, humus, or clay usually become more evident. Most of the soils in the area exhibit little horizon differentiation. The length of time that soilforming factors have been active has allowed only for accumulation of organic matter and translocation of carbonates and minor amounts of iron and clay.

For the most part, soil-forming factors have been acting on the parent material since the last period of glaciation, about 9,000 years ago. Subsequently, volcanic ash has covered most of the landscape. The last major ash fall was about 6,600 years ago.

Bottom land along streams periodically receives deposits of fresh material and consequently has no distinctly formed soils. For example, Mixed alluvial land commonly is stratified, is variable in texture, and has no evidence of soil formation because the soil material has not been in place long enough. This soil material is designated a land type.

Bisbee soils, which formed in sandy material on terraces, have an A1horizon of organic matter accumulation, but have no B horizon. Though these soils are considerably older than Mixed alluvial land, they are considered young soils because their characteristics are mainly inherited from the parent material.

In Koepke, Mires, Molson, and Republic soils, the influence of time on glacial deposits and recent volcanic ash is apparent. These soils have a thick, dark-colored A horizon and a fairly distinct B horizon. Lime has moved downward and has accumulated on the underside of gravel or in lower horizons.

The influence of time as a soil-forming factor is most evident in Hodgson soils. These soils have distinct horizons of clay accumulation and have clay films on

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ped surfaces and in pores. They also have a large accumulation of calcium carbonate in the C horizon and a leached A2 horizon above the B horizon.

Classification of the Soils

Soils are classified so that we may more easily identify their significant characteristics. Classification enables us to assemble knowledge about soils, to see their relationships to one another and to the whole environment, and to understand their behavior and their response to use. Thus, through classification, and then through the use of soil maps, we can apply our knowledge of soils to specific tracts of land.

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965 (9). Because this system is under continual study, readers interested in developments of the current system should search the latest literature available.[8]

The current system of classification has six categories. Beginning with the broadest, these categories

[8] See the unpublished working document "Selected Chapters from the Unedited Text of the Soil Taxonomy" available in the SCS State Office, Spokane, Washington.

are the order, the suborder, the great group, the subgroup, the family, and the series. The soil series of the North Ferry Area are classified in table 10 by order, subgroup, and family. Classes of the current system are briefly defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The properties used to differentiate among soil orders are those that tend to give broad climatic groupings of soils. The two exceptions to this are the Entisols and Histosols, which occur in many different climates. Each order is named with a word ending in *sol* (Ent-i-sol).

SUBORDER. Each order is divided into suborders that are based mainly on those soil characteristics that seem to produce classes with the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of waterlogging or soil differences resulting from the climate or vegetation. The last syllable in the name of a suborder indicates the order. An example is *Aquent (Aqu,* meaning water or wet, and *ent,* from Entisol).

GREAT GROUP. Soil suborders are separated into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus have accumulated; those that have pans that interfere with growth of roots, movement of water, or both; and thick, dark-colored surface horizons. The features considered are self-mulching properties of clay, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), dark-red and dark-brown colors associated with basic rocks, and the like. The names of great groups are made by adding a prefix to the name of the suborder. An example is Haplaquents *(Hapl,* meaning simple horizons, aqu for wetness or water, and *ent,* from Entisols).

SUBGROUP. Great groups are divided into subgroups, one representing the central, or typic, segment of the group, and others, called intergrades, that have properties of the group and also one or more properties of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside of the range of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group. An example is Typic Haplaquents (a typical Haplaquent).

FAMILY. Soil families are separated within a subgroup primarily on the basis of properties important to the growth of plants or on the behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence. A family name consists of a series of adjectives preceding the subgroup name. The adjectives are the class names for soil properties, such as texture and mineralogy, that are used as family differentiae. An example is the coarse-loamy, mixed, frigid family of Andic Xerochrepts.

SERIES. The soil series has the narrowest range of characteristics of the categories in the classification system. It is explained in the section "How This Survey Was Made."

Soils in the North Ferry Area are assigned to five soil orders. These orders and the subgroups that occur in the area are described in the following paragraphs.

Alfisols have a leached upper horizon abruptly underlain by a horizon in which clay has accumulated. Water percolating downward has removed carbonates from the upper horizon and deposited them in the lower one. In the North Ferry Area, the Alfisols formed in moderately fine textured glacial till and lake sediment. Typic Haploxeralfs are well drained and moderately well drained, are grayish brown to light gray, and have a clay loam or silty clay loam B horizon. Mollic Haploxeralfs contain more organic matter in the surface layer than Typic Haploxeralfs. Psammentic Haploxeralfs have horizons of clay accumulation, mostly in the form of thin lamellae.

Entisols have few, if any, clearly expressed horizons. In the North Ferry Area, they occur in material recently deposited by wind or water. They have weak granular or blocky structure or have enough accumulated organic matter to darken the surface layer. The content of organic matter, however, is low and decreases very rapidly with increasing depth. Andeptic Cryofluvents are cold, mostly brownish soils that formed in recent water-deposited sediment on bottom land. They have a layer of fine pyroclastic material in the upper 30 inches. Typic Xeropsamments are sandy soils that are moist in winter and very dry in summer. They are well drained and do not have bands of cemented silica or accumulated clay. Typic Xerorthents formed in glacial deposits and have no distinct horizons. They are mostly steep.

Inceptisols have altered horizons that have lost bases or iron and aluminum but have retained some weatherable minerals. They are the most extensive order of soils in the North Ferry Area. Particularly extensive are the Vitrandepts, which formed from parent material high in volcanic ash. Typic Vitrandepts are deeper than 20 inches over bedrock and are pale brown in the upper horizons. Mollic Vitrandepts are deeper than 20 inches over bedrock and are dark grayish brown to brown in the upper horizons. Lithic Mollic Vitrandepts are very dark gray or very dark brown in the upper horizons and are no more than 20 inches deep over bedrock. Typic Xerochrepts have light brownish-gray upper horizons, are deeper than 20 inches over bedrock, and lack ash in the surface mantle. Andic Xerochrepts have a brown or pale-brown surface layer influenced by ash or pyroclastic material and are deeper than 20 inches over bedrock. Lithic Xerochrepts have a brown or yellowish-brown surface layer and have bedrock within a depth of 20 inches. Typic Cryandepts are high in content of volcanic ash, have a dark-gray to dark grayish-brown surface layer, and formed in a cold climate. Entic Cryandepts also formed in a cold climate, but have a light brownishgray to light-brown surface layer. Andic Cryumbrepts have a dark grayish-brown or brown surface layer, have low base saturation, contain volcanic ash, and are cold. Andic Cryaquepts formed under cold and wet conditions, contain volcanic ash, and have a dark-gray or gray surface layer.

Mollisols have a surface layer in which a considerable amount of organic matter has accumulated and in

which base saturation is high. Mollisols in the North Ferry Area formed in a variety of parent materials and under dry to wet soil conditions. Haplaquolls are wet most of the year, are black to dark grayish brown, and are mottled with yellowish brown, brown, or dark brown. Cumulic Haplaquolls have a content of organic matter that decreases irregularly with increasing depth but is more than 1 percent throughout the upper 20 inches. Haploxerolls mostly are very dry in summer and moist in winter. Just below the surface, Typic Haploxerolls have an altered horizon that is brown or yellowish brown and is blocky. Calcic Haploxerolls contain a large amount of secondary calcium carbonate in the lower horizons. Cumulic Haploxerolls have a thick surface layer and formed on flood plains. The organic-matter content decreases irregularly with increasing depth. Entic Ultic Haploxerolls have no altered horizon just below the surface and are slightly acid to medium acid. Entic Haploxerolls have no altered horizon just below the surface. Fluventic Haploxerolls formed in stratified material and have an organic-matter content that decreases irregularly with increasing depth. Pachic Haploxerolls have a thick surface layer. The content of organic matter decreases with increasing depth, but is more than 1 percent to a depth of more than 20 inches.

Spodosols have amorphous mixtures of organic matter, aluminum, and perhaps iron accumulated in the soil. A light-gray or gray eluvial horizon commonly overlies the brown or strong-brown illuvial horizon in which organic matter, iron, and aluminum have accumulated. The soils typically are strongly acid to slightly acid. Spodosols in the North Ferry Area formed in areas where the temperature is cold and the annual precipitation, which is mostly snow, is 35 to 40 inches. A low evaporation rate allows much of the precipitation to pass through the soil. Entic Cryorthods are the only Spodosols in the area. They are welldrained, cold soils that formed under forest vegetation. Between depths of 1 inch and 10 inches, they have a horizon in which aluminum, iron, and organic matter have accumulated.

Climate

The climate of the North Ferry Area is influenced by the topography, the prevailing westerly winds, the path of storm systems crossing the Pacific, the cold air masses moving southward from the Arctic region, and the distance and direction from the ocean.

The Cascade Range forms a barrier to the prevailing westerly winds and in turn to the easterly movement of moist air from over the Pacific. To the east and north, the Rocky Mountains shield the area from cold air masses moving southward across Canada in winter. The north-south valleys between ranges near the border, however, permit some infiltration of Arctic air. Occasionally, air from over the interior of the continent spills over the Rockies and covers the entire Pacific Northwest. Infrequently, air from over the southern section of the United States reaches the area.

In summer, air masses from over the continent usually result in high temperatures and low relative humidity, whereas in winter, clear, dry, cold weather prevails. Most air masses crossing the area are moved eastward by prevailing westerly winds. Orographic lifting of the air as it crosses the Cascades results in heavy precipitation on the windward slopes and light precipitation in eastern Washington. In northeastern counties there is a gradual increase in precipitation because air rises from the lower valleys to the crest of the mountains. The annual precipitation in the area ranges from 12 to 18 inches in the lower valleys to 30 inches or more on the higher ridges. Approximately 50 percent falls during the period October through January, and 75 percent during October through March. Table 11 shows temperature and precipitation data for the area.

In winter, snowfall commonly ranges from 40 to 70 inches in the lower valleys to an estimated 200 inches or more on the higher mountains. Snow can be expected by the first of November on the higher slopes, where the expected depth is 6 to 10 feet. The snowpack increases from approximately 25 percent water early in winter to 40 percent in March.

Late in spring and in summer, the prevailing flow of air is from the west and northwest. This air from over the North Pacific is stable and is cooler than the surface of the land. Warming and drying air moving across the State results in a dry season beginning late in spring and reaching a peak in midsummer. The total precipitation for July and August is about 10 percent of the annual precipitation. Summer rainfall is frequently associated with thunderstorms. Hail is not unusual.

Afternoon temperatures in the valleys during the warmest summer months ranges from 80° to 90° F, but reach the upper 90's on a few days. Temperatures from 105° to 109° have been recorded. Minimum temperatures are in the 40's and 50's. On mountainsides, temperatures can be expected to decrease 3° or 4° with each 1,000-foot increase in elevation.

In winter, weather systems moving eastward from the Pacific and outbreaks of cold air from Canada produce frequent changes. Minor outbreaks of cold air occur frequently, but are usually of short duration. Maximum afternoon temperatures are from 20° to 35°, and minimums from 10° to 20°. Below freezing temperatures are recorded on most nights between mid-October and mid-April. Minimums drop to 0° or lower on 5 to 10 nights and to -10° or lower on a few nights. In some of the coldest winters, minimums have dropped to 0° or lower on 20 to 25 nights, -10° on 10 to 15 nights, -20° on 5 to 10 nights, and -30° on 1 night to 3 nights. Table 12 shows the probabilities of freezing temperatures in spring and fall at Laurier and Republic.

The loss of heat by radiation at night plus moist air results in considerable cloudiness and some fog during the colder months. The number of clear or only partly cloudy days each month is from 3 to 7 in winter, 10 to 15 in spring and fall, and 20 to 25 in summer. The area receives an estimated 15 to 20 percent of the possible sunshine in winter, 35 to 55 percent in spring and fall, and 65 to 75 percent in summer.

Topography has a decided influence on the wind. The prevailing direction above the mountains is west or

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southwest most of the year. In the valleys separating the higher ridges, the wind is usually from the north or south, depending on the pressure gradient. Winds in exposed areas can be expected to reach 50 to 60 miles per hour once in 2 years and 70 to 80 miles per hour once in 50 years.

Annual evaporation from a Weather Bureau Class A. pan is estimated at 40 to 50 inches in the warmest valleys and at 25 to 35 inches on the higher slopes. Annual loss of water by evaporation from lakes and reservoirs is estimated at 20 inches in the mountains and at 30 to 40 inches in the valleys.

Estimated evapotranspiration is shown in table 13. Evapotranspiration is the process by which water is transferred from the earth's surface to the atmosphere by evaporation of water and by transpiration from plants. Potential evapotranspiration, or the maximum amount of available moisture that could be transferred under existing temperatures, is 20 to 25 inches per year in the valleys and 12 to 18 inches in the mountains. Assuming that soils have a water-storage capacity of 6 inches, computations in table 13 are based on the actual evapotranspiration that occurs under average temperatures and precipitation. Actual amounts are 10 to 15 inches per year. In general, potential evapotrans

piration exceeds actual evapotranspiration by 10 to 12 inches.

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Glossary

Alkali soil. Generally, a highly alkaline soil. Specifically an alkali soil has so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crop plants is low from this cause.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Ash, volcanic. Small particles of solid or porous obsidian or pumice, which look like coarse ashes, ejected during volcanic activity.

Available water capacity (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. In this survey the classes used for inches of available water held in the soil to a depth of 60 inches or to bedrock are: high, 8 or more inches; moderately high, 7; moderate, 6; low, 3, 4, or 5; and very low, 2 or less.

Base saturation. The degree to which material that has base-exchange properties is saturated with exchangeable cations other than hydrogen, expressed as a percentage of the cation-exchange capacity.

Bottom land. See Flood plain.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are

Loose.-Noncoherent when dry or moist; does not hold together in a mass.

Friable.-When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.-When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.-When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.-When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.-When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.-When dry, breaks into powder or individual grains under very slight pressure.

Cemented.-Hard and brittle; little affected by moistening.

Cover crop. A close-growing crop grown primarily to improve and to protect the soil between periods of regular crop production; or a crop grown between trees and vines in orchards and vineyards.

Crop rotation. The growing of different crops in recurring succession on the same field.

Drainage class (natural). Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low available water capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and mottling in the lower B and C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time, and some soils commonly have mottling at a depth below 6 to 16 inches.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Erosion. The wearing away of the land surface by wind (sand blast), running water, and other geological agents.

Erosion hazard. Susceptibility to wind or water erosion. The terms used in this survey are *slight, moderate, severe,* and *very severe.*

Flood plain. Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

Gravelly soil material. From 15 to 50 percent of material, by volume, consists of rounded or angular rock fragments that are not prominently flattened and are up to 3 inches in diameter.

Horizon, soil. A laver of soil, approximately parallel to the surface, that has distinct characteristics produced by soil forming processes. These are the major horizons:

0 horizon.-The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.-The mineral horizon at the surface or just below an 0 horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.-The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.-The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.-Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Lacustrine deposit (geology). Material deposited in lake water and exposed by lowering of the water level or by elevation of the land.

Mottling, soil. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows : abundance-few, *common,* and *many; size-fine, medium,* and *coarse;* and contrast-faint, dis*tinct,* and *prominent.* The size measurements are these: *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in

diameter along the greatest dimension and *coarse,* more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Parent material. Disintegrated and partly weathered rock from which soil has formed.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Permeability. The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *very slow,* less than 0.06 inches per hour; *slow,* 0.06 to 0.2; *moderately slow,* 0.2 to 0.6; *moderate,* 0.6 to *2.0; moderately rapid,* 2.0 to 6.0; *rapid,* 6.0 to 20.0; and *very rapid,* more than 20.0

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Runoff. The removal of water by flow over the surface of the soil. The rapidity of runoff and the amount of water removed are closely related to slope and are also affected by such factors as texture, structure, and porosity of the surface layer; the vegetative covering; and the prevailing climate. Terms for the rate of runoff are as follows:

Ponded.-None of the water added to the soil as precipita tion or by flow from surrounding higher land escapes as runoff. Removal is by movement throughout the soil or by evaporation.

Very slow.-Surface water flows away so slowly that free water lies on the surface for long periods or enters immediately i*nto the soil. Very little of the water is removed as runoff.*

Slow.-Surface water flows away so slowly that free water covers the soil for significant periods or enters the soil so rapidly that only a small amount is removed as runoff.

Medium.-Surface water flows away at such a rate that a moderate 'proportion of the water enters the soil and free water lies on the surface for only short periods. The loss of water over the surface does not seriously reduce the supply available for plant growth. Commonly considered good external drainage.

Rapid.-A large proportion of the precipitation moves rapidly over the surface, and a small part moves through the soil.

Very rapid.-A very large part of the water moves rapidly over the surface, and a very small part moves through the soil.

Sand. Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Series, soil. A group of soils developed from a particular type of parent material and having genetic horizons that, except for texture of the surface layer, are similar in differentiating characteristics and in arrangement in the profile.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeters) to the lower limit of very fine sand (0.05 millimeters). As a textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slope, soil. The classes of slope used in this soil survey are as follows: *nearly level,* 0 to 3 percent; *gently sloping,* 3 to 8 percent; *strongly sloping,* 8 to 15 percent; *moderately steep,* 15 to 25 percent; *steep,* 25 to 45 percent; *very steep,* 45 percent or more.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure *are-platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles) adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. Technically, the part of the soil below the solum.

Surface soil. The layer in which organic matter has accumulated; that part of the profile usually stirred by plowing.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.